GATE - 2010 - EE

EE1030 : Matrix Theory
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1) A box contains 4 white balls and 3 red balls. In succession, two balls are randomly selected and removed from the box. Given that the first removed ball is white, the probability that the second removed ball is red is
   a) $\frac{1}{3}$
   b) $\frac{3}{7}$
   c) $\frac{1}{2}$
   d) $\frac{4}{7}$

2) An eigenvector of

$$P = \begin{pmatrix} 1 & 1 & 0 \\ 0 & 2 & 2 \\ 0 & 0 & 3 \end{pmatrix}$$

   is
   a) $\begin{pmatrix} -1 & 1 & 1 \end{pmatrix}^{\top}$
   b) $\begin{pmatrix} 1 & 2 & 1 \end{pmatrix}^{\top}$
   c) $\begin{pmatrix} 1 & -1 & 2 \end{pmatrix}^{\top}$
   d) $\begin{pmatrix} 2 & 1 & -1 \end{pmatrix}^{\top}$

3) For the differential equation

$$\frac{d^2x}{dt^2} + 6\frac{dx}{dt} + 8x = 0$$

   with initial conditions $x(0) = 1$ and $\left.\frac{dx}{dt}\right|_{t=0}$, the solution is
   a) $x(t) = 2e^{-6t} - e^{-2t}$
   b) $x(t) = 2e^{-2t} - e^{-4t}$
   c) $x(t) = -e^{-6t} + 2e^{-4t}$
   d) $x(t) = e^{-2t} + 2e^{-4t}$

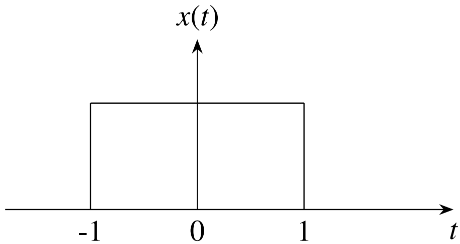
4) For the set of equations

$$\begin{aligned} x_1 + 2x_2 + x_3 + 4x_4 &= 2 \\ 3x_1 + 6x_2 + 3x_3 + 12x_4 &= 6 \end{aligned}$$

the following statement is true:

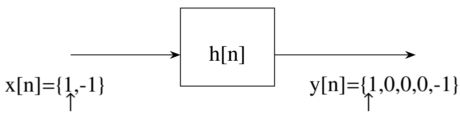
a) Only the trivial solution $x_1 = x_2 = x_3 = x_4 = 0$ exists
b) There are no solutions
c) A unique non-trivial solution exists
d) Multiple non-trivial solutions exist

5) $x(t)$ is a positive rectangular pulse from $t = -1$ to $t = +1$ with unit height as shown in the figure. The value of $\int_{-\infty}^{\infty} |X(\omega)|^2 \, d\omega$ {where $X(\omega)$ is the Fourier transform of x(t)} is



a) 2
b) 2π
c) 4
d) 4π

6) 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



h[n] = {1,0,0,1}
↑

a)

h[n] = {1,0,1}
↑

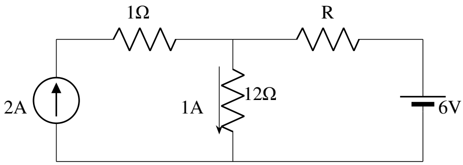
$h[n] = \{1,1,1,1\}$
$\uparrow$

b)
c)

$h[n] = \{1,1,1\}$
$\uparrow$

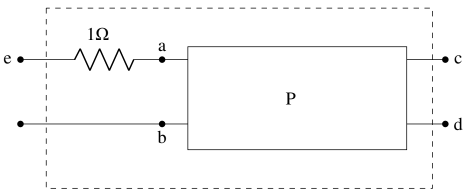
d)

7) If the 12 Ω resistor draws a current of 1 A as shown in the figure, the value of resistance R is



a) 4 Ω
b) 6 Ω
c) 8 Ω
d) 18 Ω

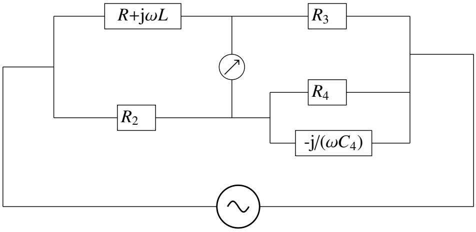
8) The two-port network P shown in the figure has ports 1 and 2, denoted by terminals (a, b) and (c, d), respectively. It has an impedance matrix Z with parameters denoted by z_{ij} .A 1Ω resistor is connected in series with the network at port 1 as shown in the figure. The impedance matrix of the modified two-port network (shown as a dashed box) is



a) $\begin{pmatrix} z_{11}+1 & z_{12}+1 \\ z_{21} & z_{22}+1 \end{pmatrix}$
b) $\begin{pmatrix} z_{11}+1 & z_{12} \\ z_{21} & z_{22}+1 \end{pmatrix}$
c) $\begin{pmatrix} z_{11}+1 & z_{12} \\ z_{21} & z_{22} \end{pmatrix}$

d) $\begin{pmatrix} z_{11}+1 & z_{12} \\ z_{21}+1 & z_{22} \end{pmatrix}$

9) The Maxwell's bridge shown in the figure is at balance. The parameters of the inductive coil are

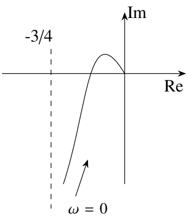


a) $R = \frac{R_2 R_3}{R_4}$, $L = C_4 R_2 R_3$
b) $L = \frac{R_2 R_3}{R_4}$, $R = C_4 R_2 R_3$
c) $R = \frac{R_4}{R_2 R_3}$, $L = \frac{1}{C_4 R_2 R_3}$
d) $L = \frac{R_4}{R_2 R_3}$, $R = \frac{1}{C_4 R_2 R_3}$

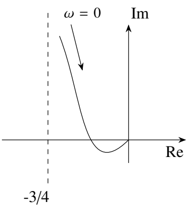
10) The frequency response of

$$G(s) = \frac{1}{[s(s+1)(s+2)]}$$

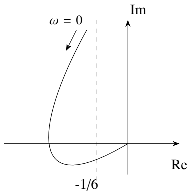
plotted in the complex G($j\omega$) plane (for $0 < \omega < \infty$) is

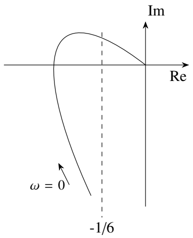


a)



b)
c)





d)

11) 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

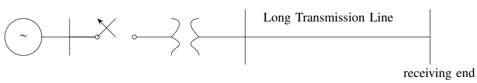
12) The characteristic equation of a closed-loop system is

$$s(s+1)(s+3) + k(s+2) = 0, \; k > 0$$

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

13) A 50 Hz synchronous generator is initially connected to a long lossless transmission line which is open circuited at the receiving end. With the field voltage held constant, the generator is disconnected from the transmission line. Which of the following may be said about the steady state terminal voltage and field current of the generator ?



a) The magnitude of terminal voltage decreases, and the field current does not change.

b) The magnitude of terminal voltage increases, and the field current does not change.
c) The magnitude of terminal voltage increases, and the field current increases.
d) The magnitude of terminal voltage does not change, and the field current decreases.