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AI24BTECH11023 - Tarun Reddy Pakala

1) The matrix $\mathbf{A}=\begin{bmatrix}\frac{3}{2} & 0 & \frac{1}{2}\\ 0 & -1 & 0\\ \frac{1}{2} & 0 & \frac{3}{2}\end{bmatrix}$ has three distinct eigenvalues and one of its eigenvectors is $\begin{bmatrix}1\\0\\1\end{bmatrix}$. Which one of the following can be another eigenvector of $\mathbf{A}$?
   a) $\begin{bmatrix}0\\0\\-1\end{bmatrix}$
   b) $\begin{bmatrix}-1\\0\\0\end{bmatrix}$
   c) $\begin{bmatrix}1\\0\\-1\end{bmatrix}$
   d) $\begin{bmatrix}1\\-1\\1\end{bmatrix}$
2) For a complex number z, $\lim_{z\to i}\frac{z^2+1}{z^3+2z-1\left(z^2+2\right)}$ is
   a) $-2i$
   b) $-i$
   c) i
   d) $2i$
3) Let $z(t) = x(t) * y(t)$ where "*" denotes convolution. Let c be a positive real-valued constant. Choose the correct expression for $z(ct)$.
   a) $c \cdot x(ct) * y(ct)$
   b) $x(ct) * y(ct)$
   c) $c \cdot x(t) * y(ct)$
   d) $c \cdot x(ct) * y(t)$
4) A solid iron cylinder is placed in a region containing a uniform magnetic field such that the cylinder axis is parallel to the magnetic field direction. The magnetic field lines inside the cylinder will
   a) bend closer to the cylinder
   b) bend farther away from the axis
   c) remain uniform as before
   d) cease to exist inside the cylinder
5) Consider an electron, a neutron and a proton initially at rest and placed along a straight line such that the neutron is exactly at the center of the line joining the electron and proton. At $t = 0$, the particles are released but are constrained to move along the same straight line. Which of these will collide first?
   a) the particles will never collide
   b) all will collide together
   c) proton and neutron
   d) electron and neutron

6) The transfer function of a system is given by.

$$\frac{V_o(s)}{V_i(s)} = \frac{1-s}{1+s}$$

Let the output of the system be $v_o(t) = V_m \sin(\omega t + \phi)$ for the input, $v_i(t) = V_m \sin(\omega t)$. Then the minimum and maximum values of ϕ (in radius) are respectively

a) $\frac{-\pi}{2}$ and $\frac{\pi}{2}$
b) $\frac{-\pi}{2}$ and 0
c) 0 and $\frac{\pi}{2}$
d) $-\pi$ and 0

7) Consider the system with following input-output relation

$$y[n] = (1 + (-1)^n)\, x[n]$$

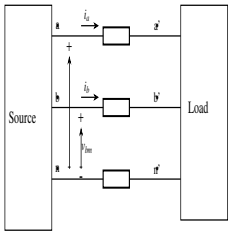
where, $x[n]$ is the input and $y[n]$ is the output. The system is

a) invertible and time invariant
b) invertible and time varying
c) non-invertible and time invariant
d) non-invertible and time varying

8) A 4 pole induction machine is working as an induction generator. The generator supply frequency is 60 Hz. The rotor current frequency is 5 Hz. The mechanical speed of the rotor in RPM is

a) 1350
b) 1650
c) 1950
d) 2250

9) A source is supplying a load through a 2-phase, 3-wire transmission system as shown in the figure below. The instantaneous voltage and current in phase are $v_{an} = 220\sin(100\pi t)\ V$ and $i_a = 10\sin(100\pi t)\ A$, respectively. Similarly for phase-b, the instantaneous voltage and current are $v_{bn} = 220\cos(100\pi t)\ V$ and $i_b = 10\cos(100\pi t)\ A$, respectively.

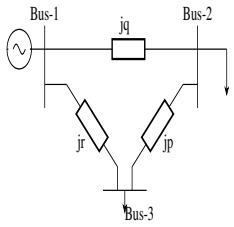


a) 2200 W
b) $2200\sin^2(100\pi t)\ W$
c) 4400 W
d) $2200\sin(100\pi t)\cos(100\pi t)\ W$

10) A 3-bus power system is shown in the figure below, where the diagonal element of Y-bus matrix are:$Y_{11} = -j12\ pu$, $Y_{22} = -j\ pu$ and $Y_{33} = -j7\ pu$.
The per unit values of the line reactances p, q and r shown in the figure are

a) $p = -0.2,\ q = -0.1,\ r = -0.5$
b) $p = 0.2,\ q = 0.1,\ r = 0.5$
c) $p = -5, ; q = -10,\ r = -2$
d) $p = 5,\ q = 10,\ r = 2$

11) A closed loop system has the characteristic equation given by $s^3 + Ks^2 + (K+2)\,s + 3 = 0$. For this system to be stable, which one of the following conditions should be satisfied?



a) $0 < K < 0.5$
b) $0.5 < K < 1$
c) $0 < K < 1$
d) $K > 1$

12) The slope and level detector circuit in a *CRO* has a delay of 100 ns. The start-stop sweep generator has a response time of 50 ns. In order to display correctly, a delay line of
a) 150 ns has to be inserted into the y-channel
b) 150 ns has to be inserted into the x-channel
c) 150 ns has to be inserted into both x and y channels
d) 100 ns has to be inserted into both x and y channels

13) The Boolean expression $AB + A\bar{C} + BC$ simplifies to
a) $BC + A\bar{C}$
b) $AB + A\bar{C} + B$
c) $AB + A\bar{C}$
d) $AB + BC$