EE-2007 52-68

AI24BTECH11012- Pushkar Gudla

1) The integral $\frac{1}{2\pi}\int_0^{2\pi}\sin(t-\tau)\cos\tau, d\tau$ equals:
   a) $\sin t\cos t$
   b) 0
   c) $\frac{1}{2}\cos t$
   d) $\frac{1}{2}\sin t$
2) $X(z) = 1-3z^{-1}$, $Y(z) = 1+2z^{-2}$ are Z-transforms of two signals $x[n], y[n]$ respectively. A linear time invariant system has the impulse response $h[n]$ defined by these two signals as:

$$h[n] = x[n-1] * y[n]$$

   where $*$ denotes discrete time convolution. Then the output of the system for the input $\delta[n-1]$ is:
   a) Has Z-transform $z^{-1}X(z)Y(z)$
   b) Equals $\delta[n-2]-3\delta[n-3]+2\delta[n-4]-6\delta[n-5]$
   c) Has Z-transform $1-3z^{-1}+2z^{-2}-6z^{-3}$
   d) Does not satisfy any of the above three
3) A loaded dice has the following probability distribution of occurrences:

Dice value	1	2	3	4	5	6
Probability	$\frac{1}{4}$	$\frac{1}{8}$	$\frac{1}{8}$	$\frac{1}{8}$	$\frac{1}{8}$	$\frac{1}{4}$

   If three identical dice as the above are thrown, the probability of occurrence of values 1, 5, and 6 on the three dice is:
   a) Same as that of occurrence of $3, 4, 5$
   b) Same as that of occurrence of $1, 2, 5$
   c) $\frac{1}{128}$
   d) $\frac{5}{8}$
4) Let x and y be two vectors in a 3-dimensional space and $< x, y >$ denote their dot product. Then the determinant

$$\det\begin{bmatrix} < x, x > & < x, y > \\ < y, x > & < y, y > \end{bmatrix}$$

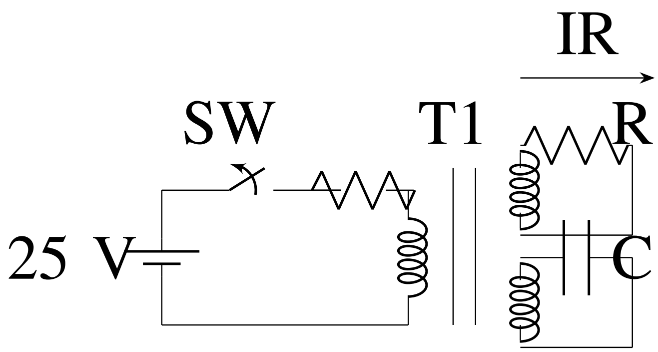
   a) is zero when x and y are linearly independent
   b) is positive when x and y are linearly independent
   c) is non-zero for all non-zero x and y
   d) is zero only when either x or y is zero
5) The linear operation $L(x)$ is defined by the cross product $L(x) = \mathbf{b}\times x$, where $\mathbf{b} = [0, 1, 0]^T$ and $x = [x_1, x_2, x_3]^T$ are three-dimensional vectors. The 3×3 matrix $\mathbf{M}$ of this operation satisfies:

$$L(x) = \mathbf{M}\begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix}$$

   Then the eigenvalues of $\mathbf{M}$ are:
   a) $0, +1, -1$

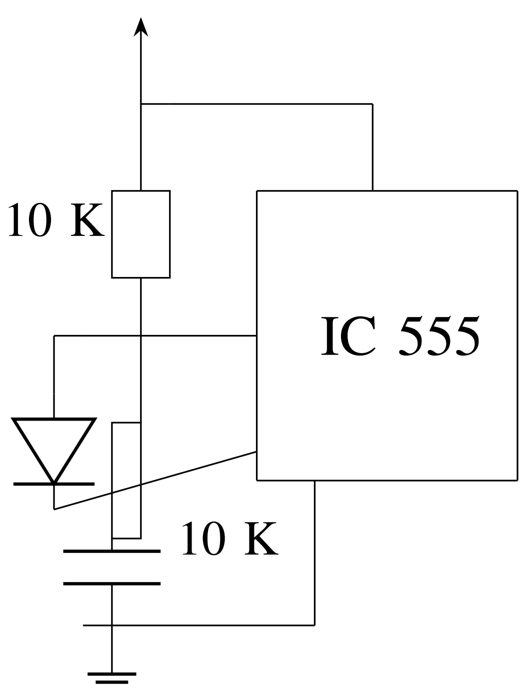
b) $1, -1, 1$
c) $i, -i, 1$
d) $i, -i, 0$

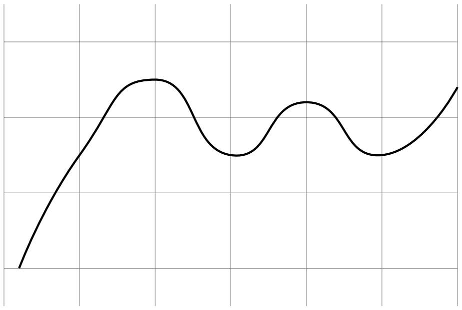
6) In the figure, transformer T_1 has two secondaries all three windings having the same number of turns and with polarities as indicated. One secondary is shorted by a 10Ω resistor R, and the other by a $15\mu F$ capacitor. The switch SW is opened ($t = 0$) when the capacitor is charged to $5V$ with the left plate as positive. At $t = 0+$ the voltage V_p and current I_R are

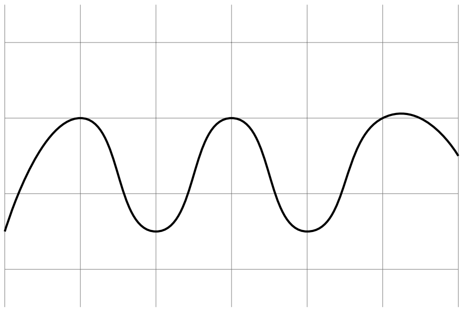


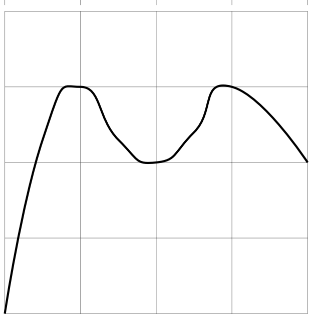
a) $-25V, 0.0A$
b) very large voltage, very large current
c) $5.0V, 0.5A$
d) $-5.0V, -5.0A$

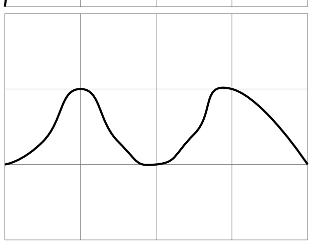
7) IC 555 in the adjacent figure is configured as an astable multivibrator. it is enabled to oscillate at $t = 0$ by applying a high input to pin 4. The pin description is: 1 and 8-supply; 2-trigger; 4-reset; 6-threshold; 7-discharge. The waveform appearing across the capacitor starting from $t = 0$, as observed on a storage CRO is:



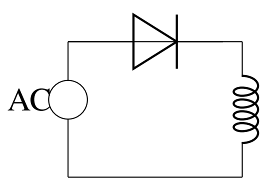
a) 

b) 

c) 

d) 

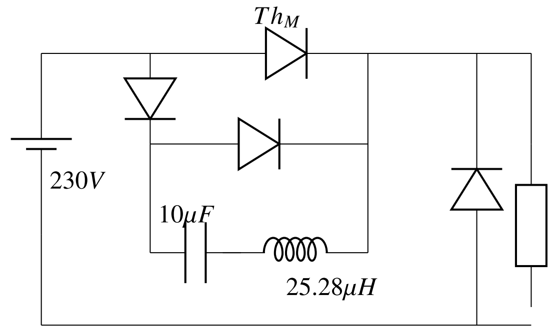
8) In the circuit figure the diode connects the ac source to a pure inductance L. The diode conducts for



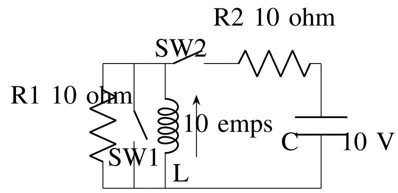
a) 90°
b) 180°
c) 270°
d) 360°

9) The circuit in the figure is a current commutated dc-dc chopper where, Th_M is the main SCR and Th_{AUX} is the auxiliary SCR. The load current is constant at 10 A. Th_M is turned OFF between

a) $0\mu s < t \leq 25\mu s$
b) $25\mu s < t \leq 50\mu s$
c) $50\mu s < t \leq 75\mu s$
d) $75\mu s < t \leq 100\mu s$

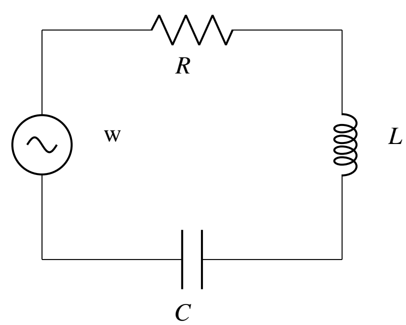


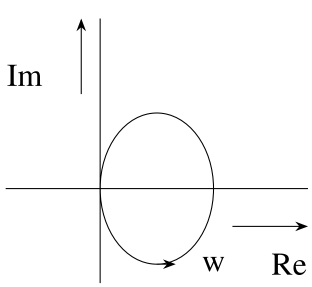
10) In the circuit shown in figure switch SW_1 is initially CLOSED and SW_2 is OPEN. The inductor L carries a current of 10 A and the capacitor is charged to 10 V with polarities as indicated. SW_2 is initially CLOSED at $t = 0-$ and SW_1 is OPENED at $t = 0$. The current through C and the voltage across L at $t = 0+$ is

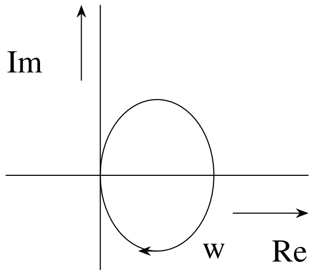


a) $55A, 4.5V$
b) $5.5A, 45V$
c) $45A, 5.5V$
d) $4.5A, 55V$

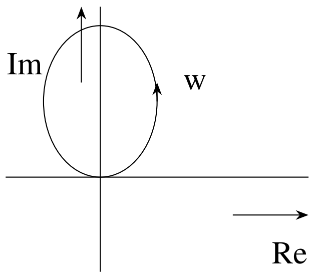
11) The R-L-C series circuit shown is supplied from a variable frequency voltage source. The admittance-locus of the R-L-C network at terminals AB for increasing frequency w is



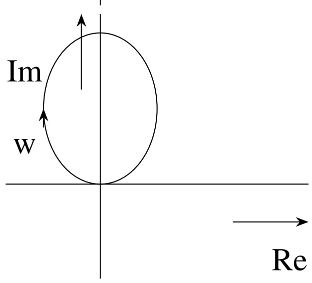
a) 



b)

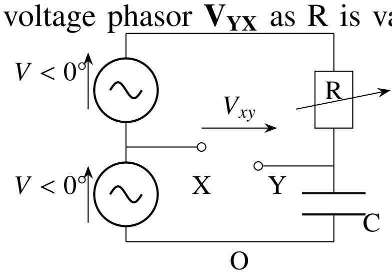


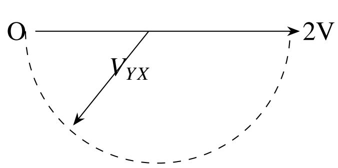
c)



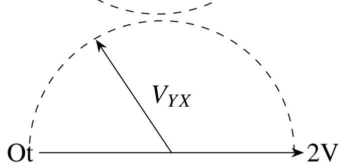
d)

12) In the figure given below all phasors are with reference to the potential at point "O". The locus of voltage phasor $\mathbf{V_{YX}}$ as R is varied from zero to infinity is shown by

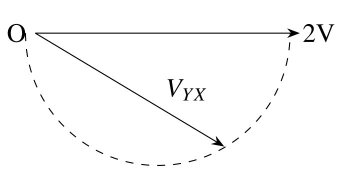




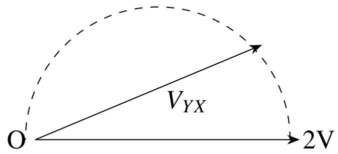
a)



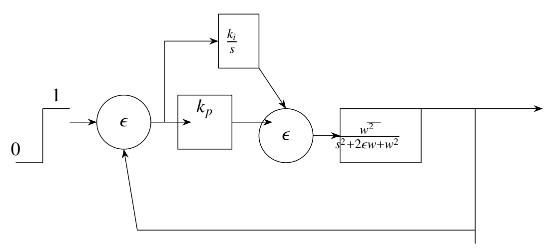
b)



c)

d) 

13) A 3 V dc supply with an internal resistance of 2Ω supplies a passive non-linear resistance characterized by the relation $V_{NL} = I_{NL}^2$. The power dissipated in the non-linear resistance is
   a) $1.0W$
   b) $1.5W$
   c) $2.5W$
   d) $3.0W$
14) Consider the feedback control system shown below which is subjected to a unit step input. The system is stable and has the following parameters $k_P = 4, K_1 = 10, w = 500$ and $\epsilon = 0.7$. The steady state value of z is.



   a) 1
   b) 0.25
   c) 0.1
   d) 0
15) A three-phase squirrel cage induction motor has a starting torque of 150% and a maximum torque of 300% with respect to rated torque at rated voltage and rated frequency. Neglect the stator resistance and rotational losses. The value of slip for maximum torque is Â
   a) 13.48%
   b) 16.24%
   c) 18.92%
   d) 26.79%
16) The matrix A given below is the node incidence matrix of a network. The columns correspond to branches of the network while the rows correspond to nodes. Let $V = [v_1 \quad v_2 \quad ...v_6]^T$ denote the vector of branch voltages while $I = [i_1 i_2 ... i_6]^T$ that of branch currents. The vector $E = [e_1 \quad e_2 \quad e_3 \quad e_4]^T$ denotes the vector of node voltages relative to a common ground. Â

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

   Which of the following statements is true?
   a) The equations $v_1 - v_2 + v_3 = 0$, $v_3 + v_4 - v_5 = 0$ are KVL equations for the network for some loops
   b) The equations $v_1 - v_3 - v_6 = 0][v_4 + v_5 - v_6 = 0$ are KVL equations for the network for some loops
   c) $E = AV$
   d) $AV = 0$ are KVL equations for the network
17) An isolated 50 Hz synchronous generator is rated at $15MW$, which is also the maximum continuous power limit of its prime mover. It is equipped with a speed governor with 5% droop. Initially, the

generator is feeding three loads of $4MW$ each at 50 Hz. One of these loads is programmed to trip permanently if the frequency falls below $48Hz$. If an additional load of $3.5MW$ is connected, then the frequency will settle down to Â

a) $49.417Hz$
b) $49.917Hz$
c) $50.083Hz$
d) $50.583Hz$