

EE-2007 52-68

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- 1) The integral $\frac{1}{2\pi} \int_0^{2\pi} \sin(t - \tau) \cos \tau, d\tau$ equals:
- $\sin t \cos t$
 - 0
 - $\frac{1}{2} \cos t$
 - $\frac{1}{2} \sin t$
- 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:

- Has Z-transform $z^{-1}X(z)Y(z)$
 - Equals $\delta[n - 2] - 3\delta[n - 3] + 2\delta[n - 4] - 6\delta[n - 5]$
 - Has Z-transform $1 - 3z^{-1} + 2z^{-2} - 6z^{-3}$
 - 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:

- Same as that of occurrence of 3, 4, 5
 - Same as that of occurrence of 1, 2, 5
 - $\frac{1}{128}$
 - $\frac{5}{8}$
- 4) Let x and y be two vectors in a 3-dimensional space and $\langle x, y \rangle$ denote their dot product. Then the determinant

$$\det \begin{bmatrix} \langle x, x \rangle & \langle x, y \rangle \\ \langle y, x \rangle & \langle y, y \rangle \end{bmatrix}$$

- is zero when x and y are linearly independent
 - is positive when x and y are linearly independent
 - is non-zero for all non-zero x and y
 - 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:

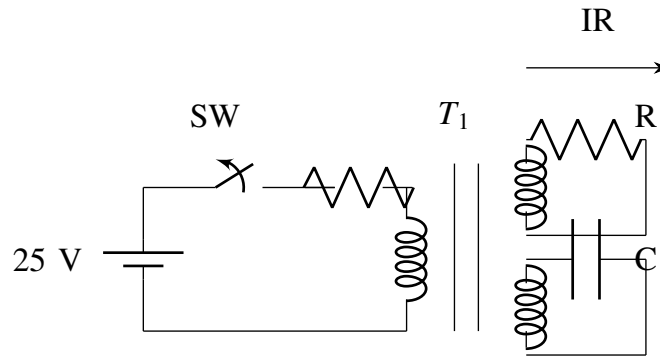
$$L(x) = \mathbf{M} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix}$$

Then the eigenvalues of \mathbf{M} are:

- 0, +1, -1

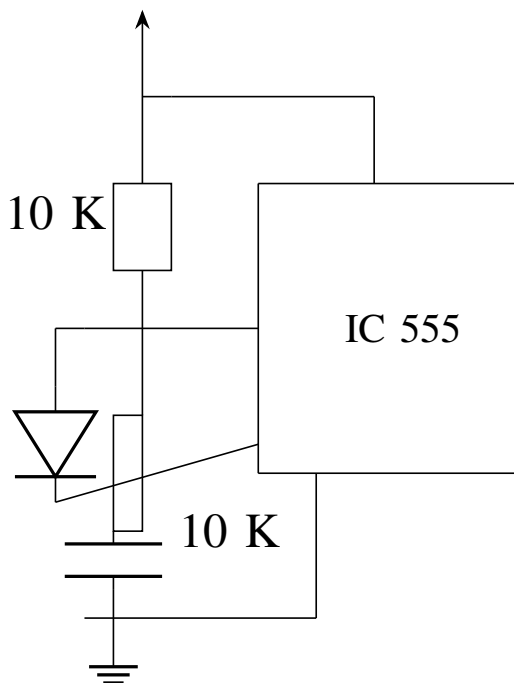
- b) $1, -1, 1$
- c) $i, -i, 1$
- d) $i, -i, 0$

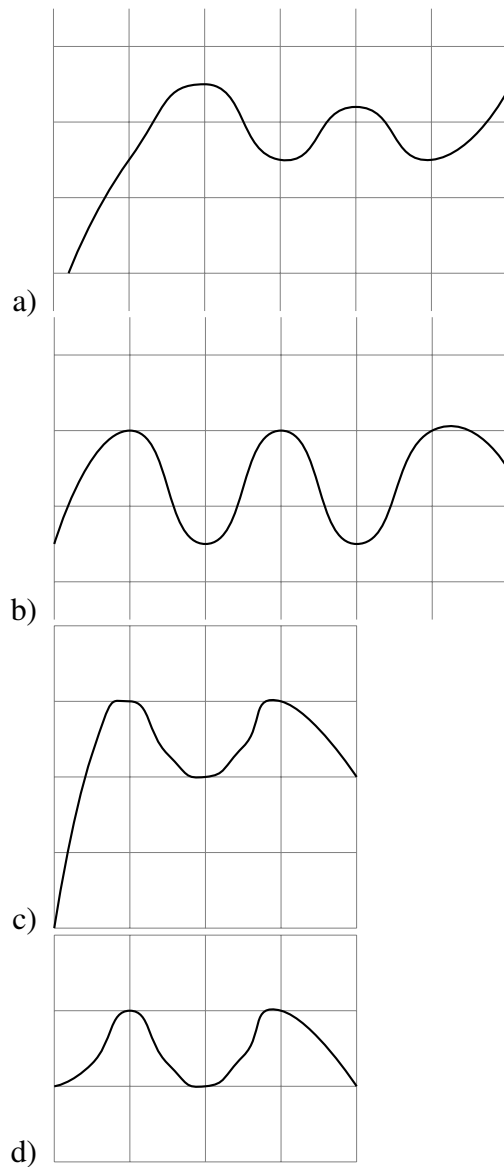
6) In the figure, transformer T_1 has two secondaries all three windings having the same number of turns and with polarities as indicated. One secondary is shorted by a 10Ω resistor R , and the other by a $15\mu F$ capacitor. The switch SW is opened ($t = 0$) when the capacitor is charged to $5V$ with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



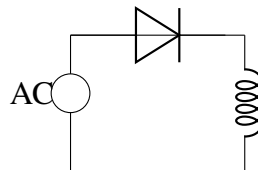
- a) $-25V, 0.0A$
- b) very large voltage, very large current
- c) $5.0V, 0.5A$
- d) $-5.0V, -5.0A$

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:





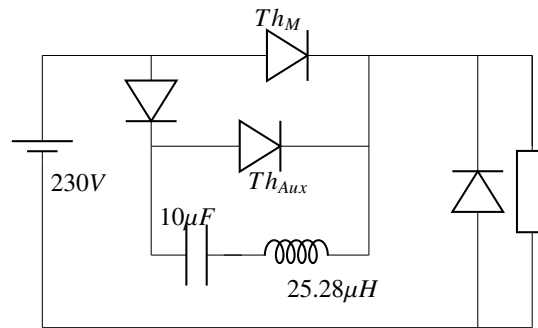
8) In the circuit figure the diode connects the ac source to a pure inductance L . The diode conducts for



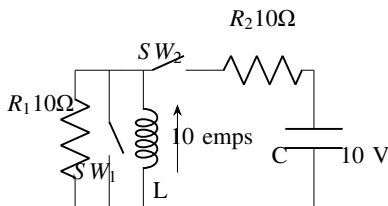
- a) 90°
- b) 180°
- c) 270°
- d) 360°

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

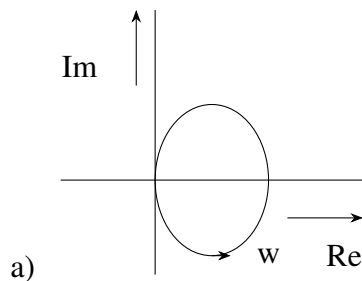
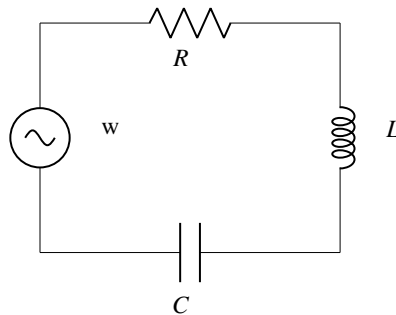
- a) $0\mu s < t \leq 25\mu s$
- b) $25\mu s < t \leq 50\mu s$
- c) $50\mu s < t \leq 75\mu s$
- d) $75\mu s < t \leq 100\mu s$

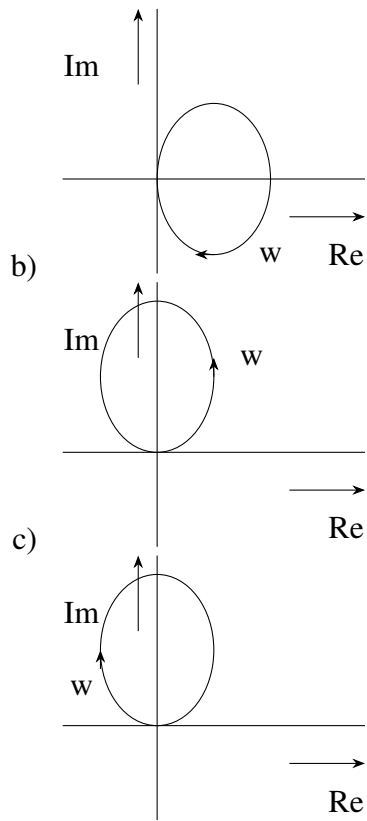


- 10) In the circuit shown in figure switch SW_1 is initially CLOSED and SW_2 is OPEN. The inductor L carries a current of 10 A and the capacitor is charged to 10 V with polarities as indicated. SW_2 is initially CLOSED at $t = 0^-$ and SW_1 is OPENED at $t = 0$. The current through C and the voltage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

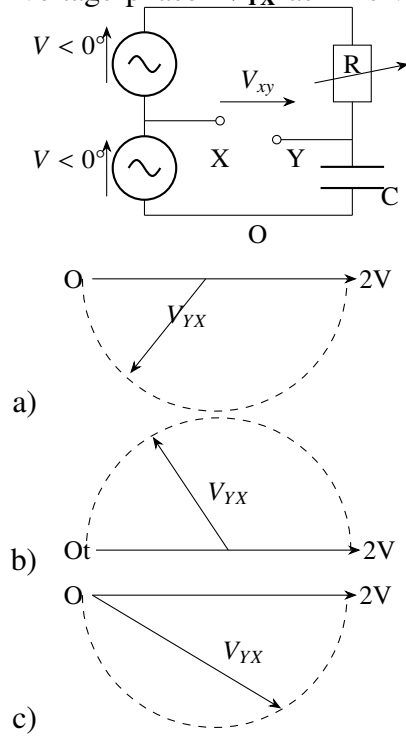


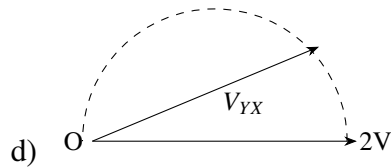
- a) 55A, 4.5V
 b) 5.5A, 45V
 c) 45A, 5.5V
 d) 4.5A, 55V
- 11) The R-L-C series circuit shown is supplied from a variable frequency voltage source. The admittance-locus of the R-L-C network at terminals AB for increasing frequency ω is



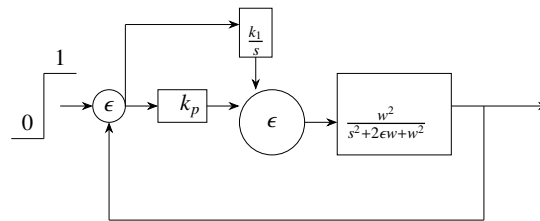


- 12) In the figure given below all phasors are with reference to the potential at point "O". The locus of voltage phasor V_{YX} as R is varied from zero to infinity is shown by





- 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
- 1.0W
 - 1.5W
 - 2.5W
 - 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.



- 1
- 0.25
- 0.1
- 0

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 \hat{A}

- 13.48%
- 16.24%
- 18.92%
- 26.79%

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 $V = [v_1 \ v_2 \ \dots v_6]^T$ denote the vector of branch voltages while $I = [i_1 i_2 \dots i_6]^T$ that of branch currents. The vector $E = [e_1 \ e_2 \ e_3 \ e_4]^T$ denotes the vector of node voltages relative to a common ground. \hat{A}

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

Which of the following statements is true?

- 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
- 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
- $E = AV$
- $AV = 0$ are KVL equations for the network

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 \hat{A}

- 1) $49.417Hz$
- 2) $49.917Hz$
- 3) $50.083Hz$
- 4) $50.583Hz$