

# 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  $3 \times 3$  matrix  $\mathbf{M}$  of this operation satisfies:

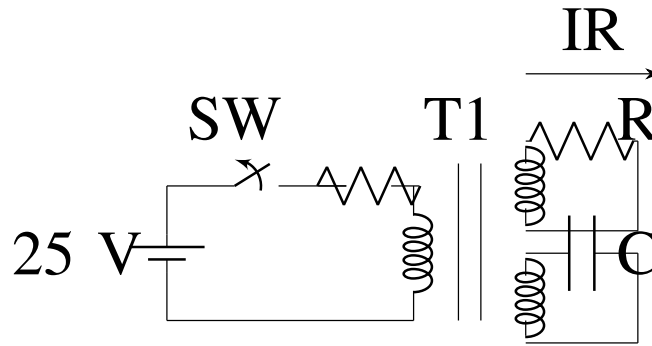
$$L(x) = \mathbf{M} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix}$$

Then the eigenvalues of  $\mathbf{M}$  are:

- 0, +1, -1

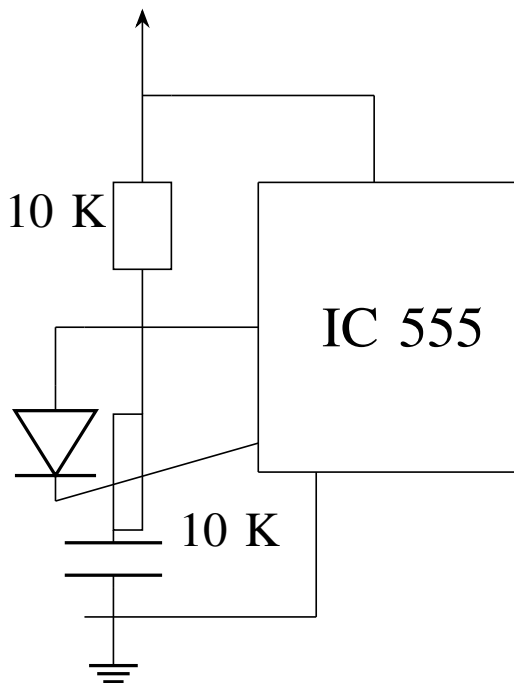
- b)  $1, -1, 1$
- c)  $i, -i, 1$
- d)  $i, -i, 0$

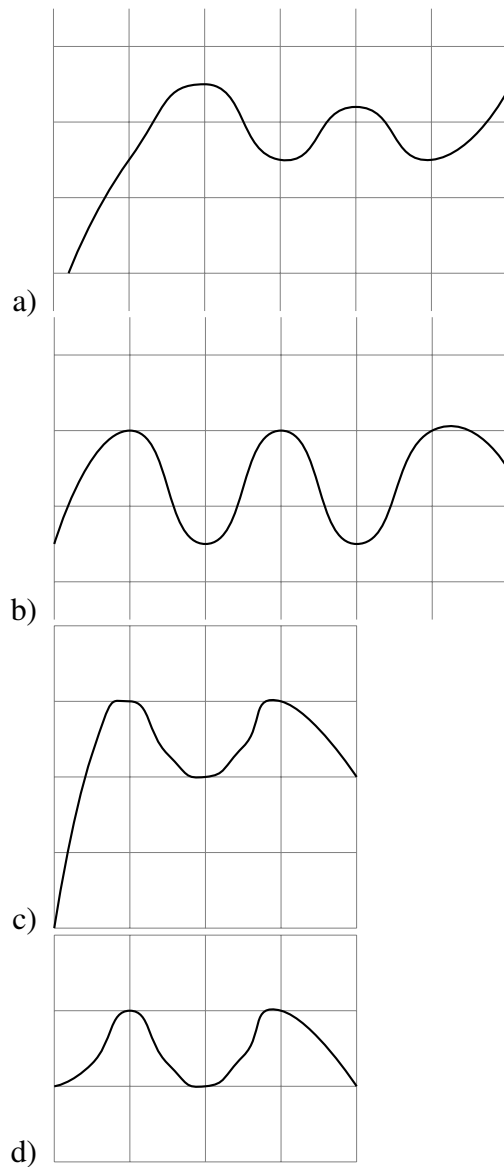
6) In the figure, transformer  $T_1$  has two secondaries all three windings having the same number of turns and with polarities as indicated. One secondary is shorted by a  $10\Omega$  resistor  $R$ , and the other by a  $15\mu F$  capacitor. The switch  $SW$  is opened ( $t = 0$ ) when the capacitor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



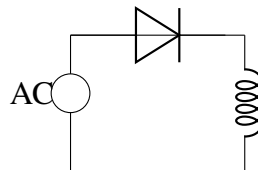
- a)  $-25V, 0.0A$
- b) very large voltage, very large current
- c)  $5.0V, 0.5A$
- d)  $-5.0V, -5.0A$

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:





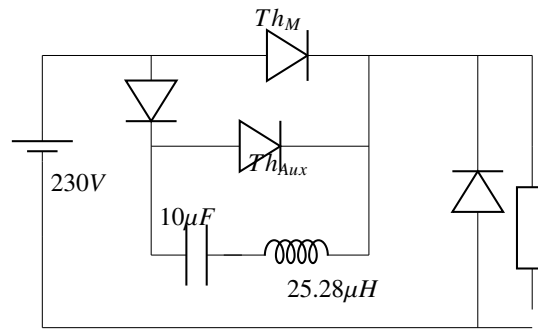
8) In the circuit figure the diode connects the ac source to a pure inductance L. The diode conducts for



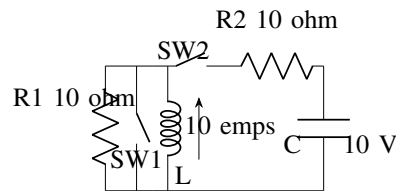
- a)  $90^\circ$
- b)  $180^\circ$
- c)  $270^\circ$
- d)  $360^\circ$

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

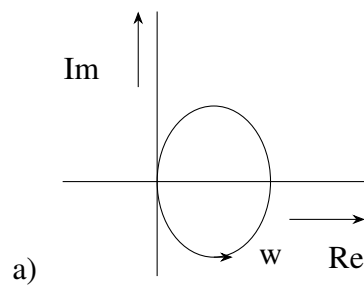
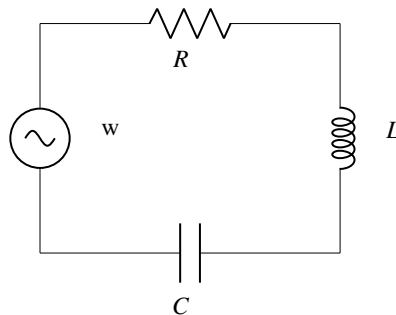
- a)  $0\mu s < t \leq 25\mu s$
- b)  $25\mu s < t \leq 50\mu s$
- c)  $50\mu s < t \leq 75\mu s$
- d)  $75\mu s < t \leq 100\mu s$

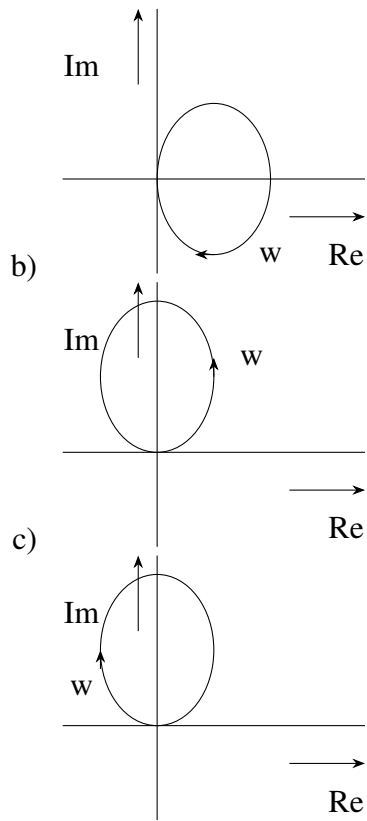


- 10) In the circuit shown in figure switch  $SW_1$  is initially CLOSED and  $SW_2$  is OPEN. The inductor  $L$  carries a current of 10 A and the capacitor is charged to 10 V with polarities as indicated.  $SW_2$  is initially CLOSED at  $t = 0^-$  and  $SW_1$  is OPENED at  $t = 0$ . The current through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

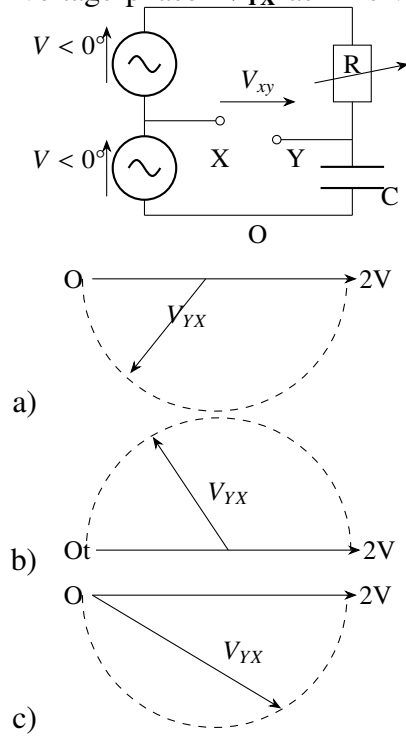


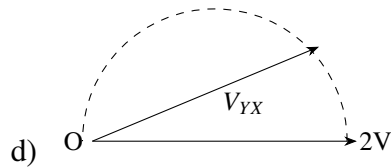
- a) 55A, 4.5V  
 b) 5.5A, 45V  
 c) 45A, 5.5V  
 d) 4.5A, 55V
- 11) The R-L-C series circuit shown is supplied from a variable frequency voltage source. The admittance-locus of the R-L-C network at terminals AB for increasing frequency  $\omega$  is



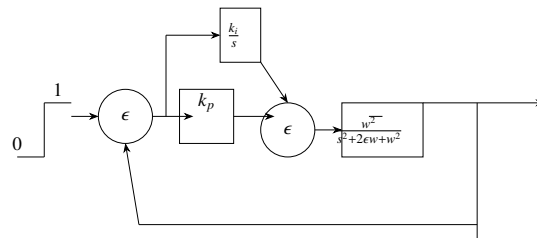


- 12) In the figure given below all phasors are with reference to the potential at point "O". The locus of voltage phasor  $V_{YX}$  as R is varied from zero to infinity is shown by





- 13) A 3 V dc supply with an internal resistance of  $2\Omega$  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
- 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  $\hat{A}$
- 13.48%
  - 16.24%
  - 18.92%
  - 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  $V = [v_1 \ v_2 \ \dots v_6]^T$  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
- 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  $50\text{ Hz}$ . 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  $\hat{A}$

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