

Assignment 1

EE24BTECH11049
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1) The integral

$$\frac{1}{2\pi} \int_0^{2\pi} \sin(t - \tau) \cos \tau d\tau$$

equals

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- 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 the 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 $\delta[n - 1]$

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- 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	$\frac{1}{4}$	$\frac{1}{8}$	$\frac{1}{8}$	$\frac{1}{8}$	$\frac{1}{8}$	$\frac{1}{4}$

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- a) same as the occurrence of 3, 4, 5
b) same as the occurrence of 1, 2, 5
c) $\frac{1}{128}$
d) $\frac{5}{8}$
- 4) let x and y be vectors in a three dimensional space and $\langle x, y \rangle$ denote their dot product. Then the determinant

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

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- 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 when either of x or y is zero

5) The linear operator $L(\mathbf{x})$ is defined by the cross product $L(\mathbf{x}) = \mathbf{b} \times \mathbf{x}$, where $\mathbf{b} = \begin{pmatrix} 0 & 1 & 0 \end{pmatrix}^T$ and $\mathbf{x} = \begin{pmatrix} x_1 & x_2 & x_3 \end{pmatrix}^T$ are three dimensional vectors. The 3×3 matrix M of this operation satisfies

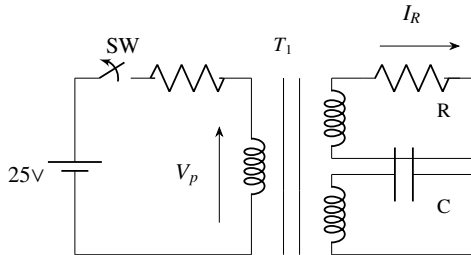
$$L(\mathbf{x}) = M \begin{pmatrix} x_1 \\ x_2 \\ x_3 \end{pmatrix}$$

Then the eigenvalues of M are

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

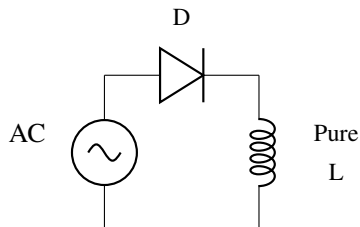
6) In the figure transformer T_1 has two secondaries, all three windings having same number turns and with polarities as indicated. One secondary is shorted by a 10Ω resistor R , and the other by a $15\mu F$ capacitor. The switch SW is opened ($t = 0$) when the capacitor is charged to $5V$ with the left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



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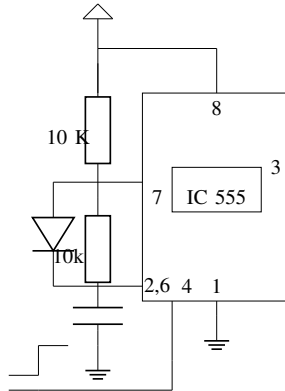
- a) $-25V, 0.0A$
 b) very large voltage, very large current
 c) $5.0V, 0.5A$
 d) $-5.0V, -5.0A$

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

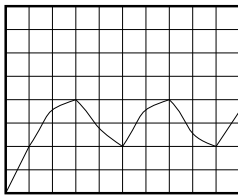


a) 90° b) 180° c) 270° d) 360°

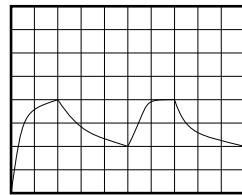
- 8) IC 555 in the adjacent figure is configured as an stable multivibrator. It is enabled to oscillate at $t = 0$ by applying a high input to pin 4. The pin description is: 1 and 8-supply; 2-trigger; 4-reset; 6-threshold; 7-discharge. The waveform appearing across the capacitor starting from $t = 0$,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



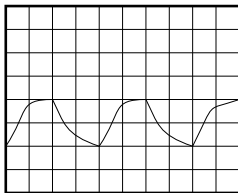
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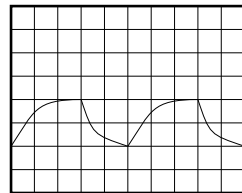
a)



c)

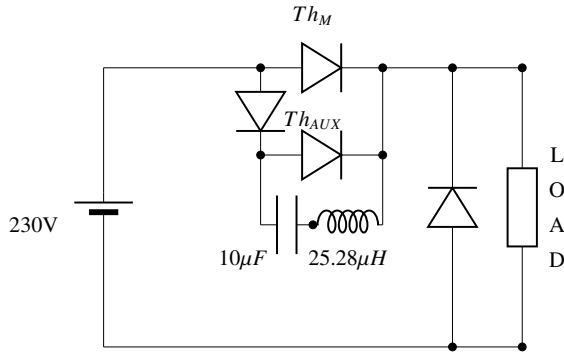


b)



d)

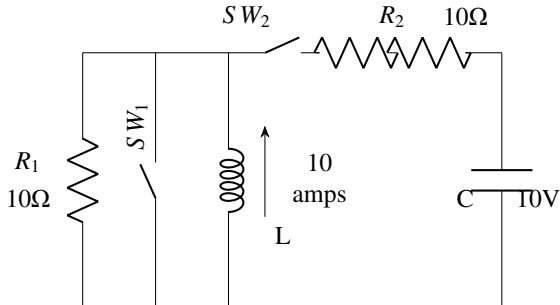
- 9) The circuit in the figure is a current commutated dc - dc chopper where, Th_M is the main SCR and Th_{AUX} is the auxiliary SCR. The load current is constant at $t = 0$. Th_M is turned OFF between



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- 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) $75\mu s < t \leq 100\mu s$

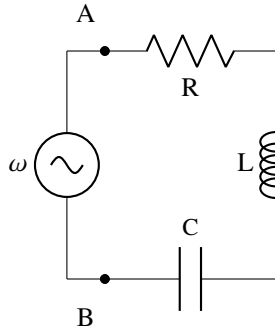
- 10) In the circuit shown in figure switch SW_1 is initially CLOSED and SW_2 is OPEN. The inductor L carries a current of 10A and the capacitor is charged to 10V with polarities as indicated. SW_2 is initially CLOSED at $t = 0^-$ and SW_1 is OPENED at $t = 0$. The current through C and the voltage across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



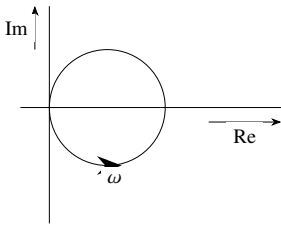
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- a) 55A, 4.5V
- b) 5.5A, 45V
- c) 45A, 5.5V
- d) 4.5A, 55V

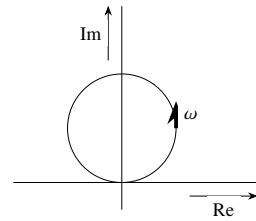
- 11) The R-L-C series circuit shown is supplied from a variable frequency voltage source. The admittance-locus of the R-L-C network at terminals AB for increasing frequency ω is



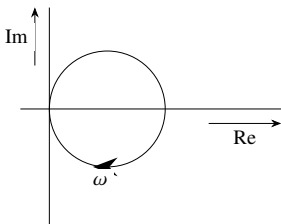
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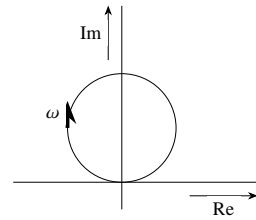
a)



c)

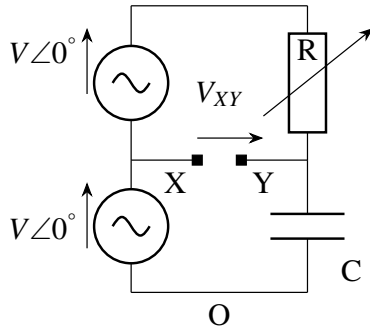


b)

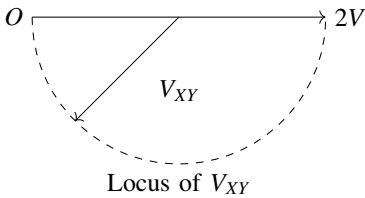


d)

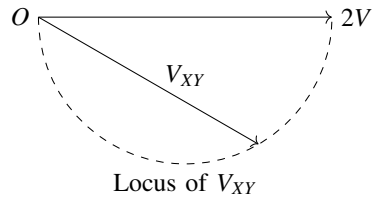
- 12) In the figure given below all phasors are with reference to the potential at point "O".
The locus of voltage phasor \mathbf{v}_{XY} as R is varied from zero to infinity is shown by



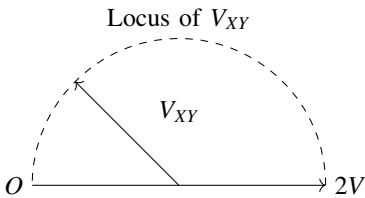
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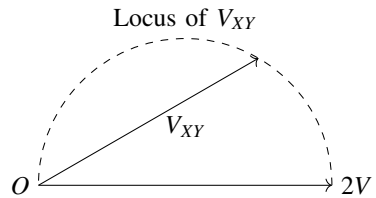
a)



c)



b)

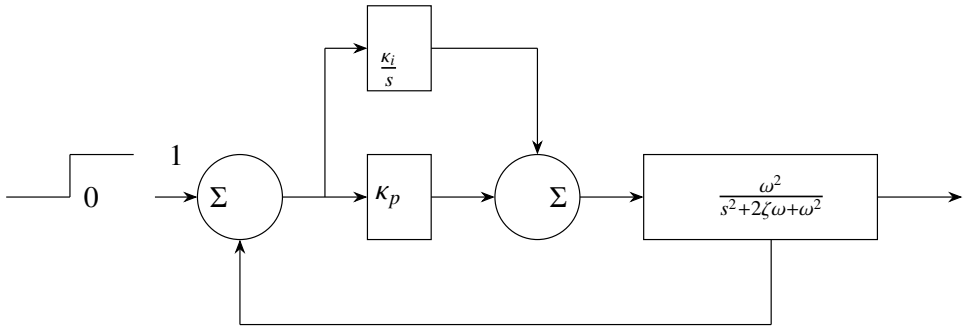


d)

- 13) A 3V 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 non-linear resistance is (2007-EE)

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 parameter $\kappa_P = 4$, $\kappa_i = 10$, $\omega = 500$ and $\zeta = 0.7$



The steady state value of z is

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- 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 300% with respect to rated torque at rated voltage and rate frequency. Neglect the stator resistance and rotational losses. The value of slip for maximum torque

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- a) 13.48% b) 16.24% c) 18.92% d) 27.79%

16) The matrix A given below is the node incidence matrix of network. The columns correspond to the branches of the network while the rows correspond nodes. Let $\mathbf{V} = [v_1 v_2 \dots v_6]^T$ denote the vector of branch voltages while $\mathbf{I} = [i_1 i_2 \dots i_6]^T$ that of branch currents. The vector $\mathbf{E} = [e_1 e_2 \dots e_6]^T$ denotes the vector of node voltages relative to common ground.

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

Which of the following statements are true?

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- a) The equations $v_1 - v_2 + v_3 = 0$, $v_3 + v_4 - v_5 = 0$ are the KVL equations for the networks for some loops
b) The equations $v_1 - v_3 - v_6 = 0$, $v_4 + v_5 - v_6 = 0$ are the KVL equations for the networks for some loops
c) $\mathbf{E} = \mathbf{AV}$
d) $\mathbf{AV} = 0$ are KVL equations for the network

17) An isolated 50Hz synchronous generator is rated at 15MW which is also the maximum continuous power limit of its prime mover. It is equipped with a speed a speed governor with 5% droop. Initially, the generator is feeding three loads of 4MW each at 50Hz. One of these loads is programmed to trip PERMANENTLY if the frequency falls below 48Hz. If an additional load 3.5MW is connected then frequency will settle down to

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a) $49.417Hz$

b) $49.917Hz$

c) $50.083Hz$

d) $50.583Hz$