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

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 $\delta[n-1]$

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

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

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

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

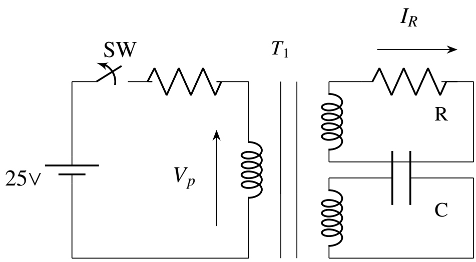
5) The linear operater $L(\mathbf{x})$ is defined by the cross product $L(\mathbf{x}) = \mathbf{b} \times \mathbf{x}$, where $\mathbf{b} = \begin{pmatrix} 0 & 1 & 0 \end{pmatrix}^T$ and $\mathbf{x} = \begin{pmatrix} x_1 & x_2 & x_3 \end{pmatrix}^T$ are three dimensional vectors. The 3×3 matrix M of this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

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

Then the eigenvalues of M are

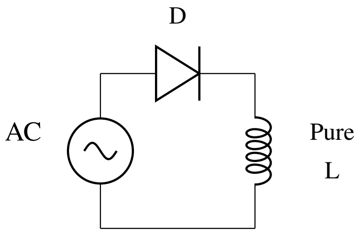
a) $0, +1, -1$ b) $1, -1, 1$ c) $\iota, -\iota, 1$ d) $\iota, -\iota, 0$

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



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

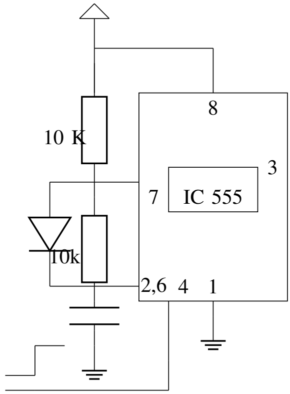
7) In the circuit of the adjacent figure the diode connects the ac source to a pure inductance L. The diode conducts for

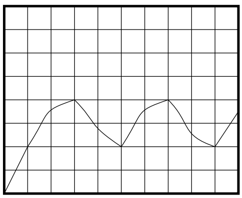


a) 90° b) 180° c) 270° d) 360°

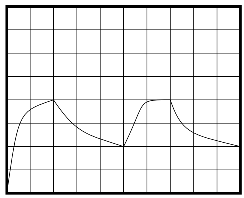
8) IC 555 in the adjacent figure is configured as an stable multivibrator. It is enabled to oscillate at $t = 0$ by applying a hight input to pin 4. The pin description is: 1

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

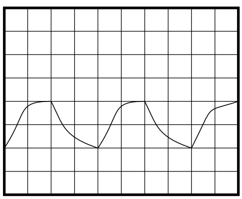




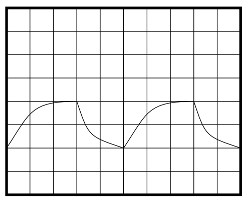
a)



c)

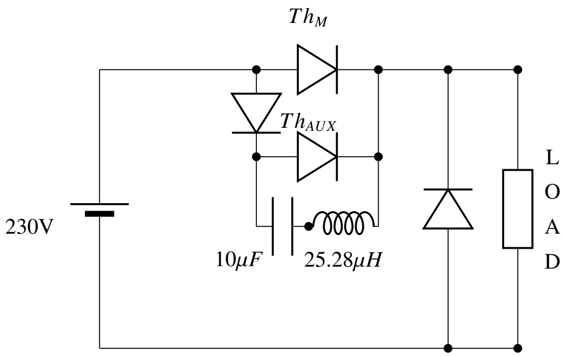


b)



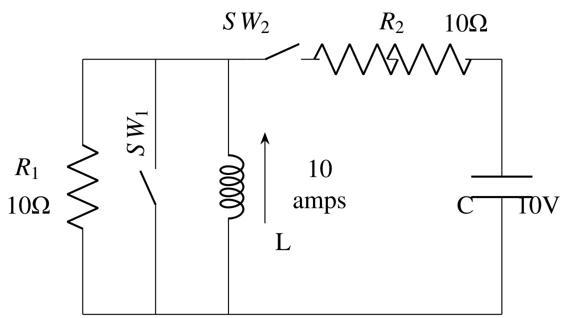
d)

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 si turned OFF between



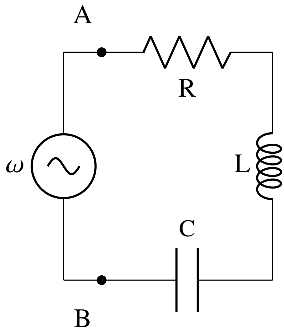
a) $0\mu s < t \leq 25\mu s$
b) $25\mu s < t \leq 50\mu s$
c) $50\mu s < t \leq 75\mu s$
d) $75\mu s < t \leq 100\mu s$

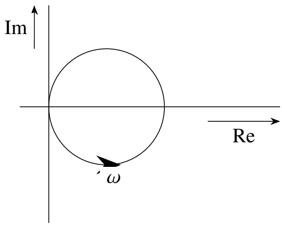
10) In the circuit shown in figure switch SW_1 is initially CLOSED and SW_2 is OPEN. The inductor L carries a current of $10A$ and the capacitor is charged to $10V$ with polarities as indicated. SW_2 is initially CLOSED at $t = 0-$ and SW_1 is OPENED at $t = 0$. The current through C and the voltage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



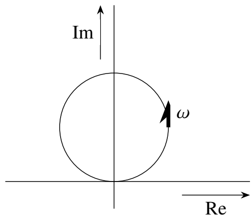
a) $55A$, $4.5V$ b) $5.5A$, $45V$ c) $45A$, $5.5V$ d) $4.5A$, $55V$

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





a)



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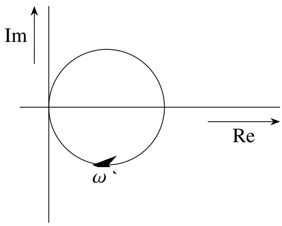
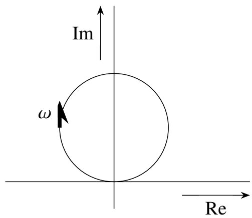
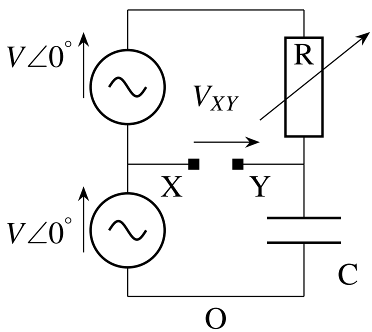


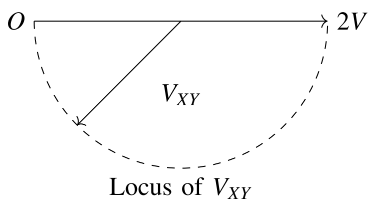
b)



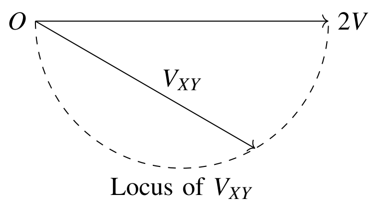
d)

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

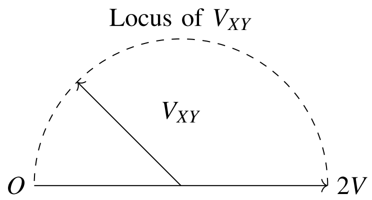




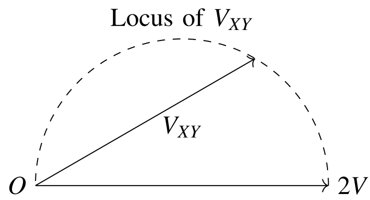
a)



c)



b)

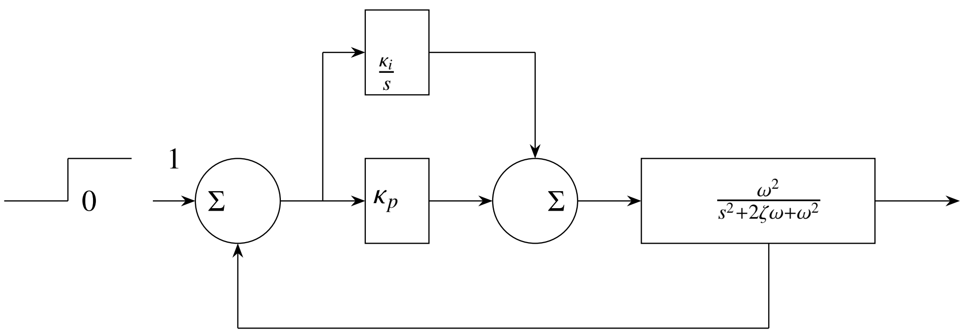


d)

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

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

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

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?

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) $\mathbf{E} = A\mathbf{V}$
d) $A\mathbf{V} = 0$ 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

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