

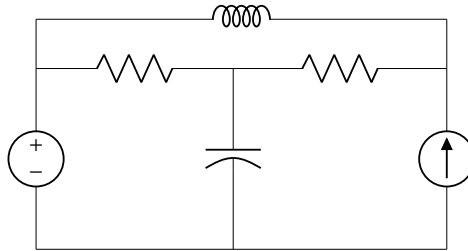
# GATE - 2008 - EE

EE1030 : Matrix Theory  
Indian Institute of Technology Hyderabad

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AI24BTECH11009

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- 1) The number of chords in the graph of the given circuit will be



- a) 3  
b) 4  
c) 5  
d) 6
- 2) The Thevenin's equivalent of a circuit operating at  $\omega = 5$  rad/s, has  $V_{oc} = 3.71 \angle -15.9^\circ V$  and  $Z_o = 2.38 - j0.667 \Omega$ . At this frequency, the minimal realization of the Thevenin's impedance will have a
- a) resistor and a capacitor and an inductor  
b) resistor and a capacitor  
c) resistor and an inductor  
d) capacitor and an inductor
- 3) A signal  $e^{-\alpha t} \sin(\omega t)$  is the input to a real Linear Time Invariant system. Given  $K$  and  $\phi$  are constants, the output of the system will be of the form  $Ke^{-\beta t} \sin(\nu t + \phi)$  where
- a)  $\beta$  need not be equal to  $\alpha$  but  $\nu$  equal to  $\omega$   
b)  $\nu$  need not be equal to  $\omega$  but  $\beta$  equal to  $\alpha$   
c)  $\beta$  equal to  $\alpha$  and  $\nu$  is equal to  $\omega$   
d)  $\beta$  need not be equal to  $\alpha$  and  $\nu$  need not be equal to  $\omega$

- 4)  $X$  is a uniformly distributed random variable that takes values between 0 and 1. The value of  $E\{X^3\}$  will be
- 0
  - $\frac{1}{8}$
  - $\frac{1}{4}$
  - $\frac{1}{2}$

- 5) The characteristic equation of a  $(3 \times 3)$  matrix  $\mathbf{P}$  is defined as

$$\alpha(\lambda) = |\lambda \mathbf{I} - \mathbf{P}| = \lambda^3 + \lambda^2 + 2\lambda + 1 = 0$$

If  $\mathbf{I}$  denotes identity matrix, then the inverse of matrix  $\mathbf{P}$  will be

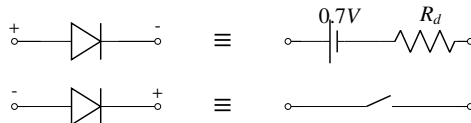
- $(\mathbf{P}^2 + \mathbf{P} + 2\mathbf{I})$
  - $(\mathbf{P}^2 + \mathbf{P} + \mathbf{I})$
  - $-(\mathbf{P}^2 + \mathbf{P} + \mathbf{I})$
  - $-(\mathbf{P}^2 + \mathbf{P} + 2\mathbf{I})$
- 6) If the rank of a  $(5 \times 6)$  matrix  $\mathbf{Q}$  is 4, then which one of the following statements is correct?
- $\mathbf{Q}$  will have four linearly independent rows and four linearly independent columns
  - $\mathbf{Q}$  will have four linearly independent rows and five linearly independent columns
  - $\mathbf{Q}\mathbf{Q}^\top$  will be invertible
  - $\mathbf{Q}^\top\mathbf{Q}$  will be invertible

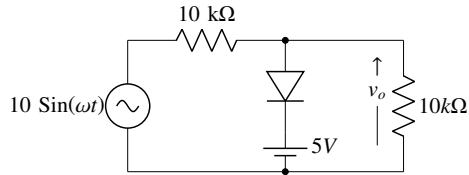
- 7) A function  $y(t)$  satisfies the following differential equation:

$$\frac{dy(t)}{dt} + y(t) = \delta(t)$$

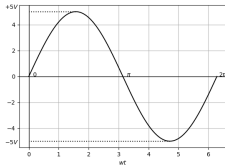
where  $\delta(t)$  is the delta function. Assuming zero initial condition, and denoting the unit step function by  $u(t)$ ,  $y(t)$  can be of form

- $e^t$
  - $e^{-t}$
  - $e^t u(t)$
  - $e^{-t} u(t)$
- 8) The equivalent circuits of a diode, during forward biased and reverse biased conditions, are shown in the figure

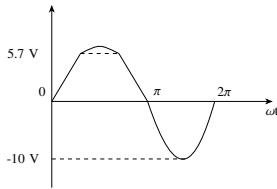




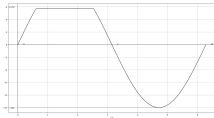
If such a diode is used in clipper circuit of figure given above, the output voltage ( $v_o$ ) of the circuit will be



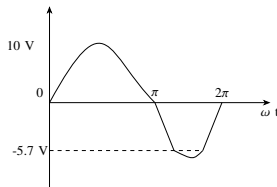
a)



b)



c)



d)

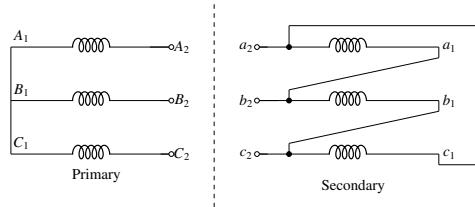
9) Two 8-bit ADCs, one of single slope integrating type and the other of successive approximation type, take  $T_A$  and  $T_B$  times to convert a 5 V analog input signal to an equivalent digital output. If the input analog signal is reduced to 2.5 V, the approximate time taken by the two ADCs will respectively, be

- $T_A, T_B$
- $\frac{T_A}{2}, \frac{T_B}{2}$
- $T_A, \frac{T_B}{2}$
- $\frac{T_A}{2}, \frac{T_B}{2}$

10) An input device is interfaced with Intel 8085A microprocessor as memory mapped I/O. The address of the device is 2500H. In order to input data from the device to accumulator, the sequence of instructions will be

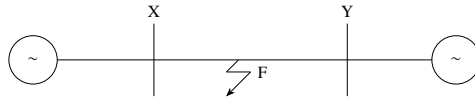
- a) LXI H, 2500H  
MOV A, M
- b) LXI H, 2500H  
MOV M, A
- c) LHLD 2500H  
MOV A, M
- d) LHLD 2500H  
MOV M, A

- 11) Distributed winding and short chording employed in AC machines will result in
- a) increase in emf and reduction in harmonics.
  - b) reduction in emf and increase in harmonics.
  - c) increase in both emf and harmonics.
  - d) reduction in both emf and harmonics.
- 12) Three single-phase transformers are connected to form a 3-phase transformer bank.  
The transformers are connected in the following manner:



The transformer connection will be represented by

- a) Yd0
  - b) Yd1
  - c) Yd6
  - d) Yd11
- 13) In a stepper motor, the detent torque means
- a) minimum of the static torque with the phase winding excited.
  - b) maximum of the static torque with the phase winding excited.
  - c) minimum of the static torque with the phase winding unexcited.
  - d) maximum of the static torque with the phase winding unexcited.
- 14) A two machine power system is shown below. Transmission line  $XY$  has positive sequence impedance of  $Z_1\Omega$  and zero sequence impedance of  $Z_0\Omega$ .



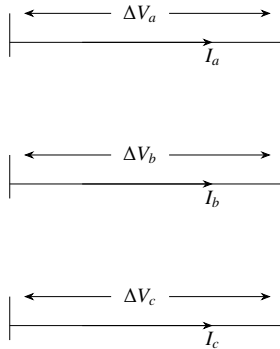
An 'a' phase to ground fault with zero fault impedance occurs at the centre of the transmission line. Bus voltage at  $X$  and line current from  $X$  to  $F$  for the phase 'a', are given by  $V_a$  Volts and  $I_a$  Amperes, respectively. Then, the impedance measured by the ground distance relay located at the terminal  $X$  of line  $XY$  will be given by

- a)  $\frac{Z_1}{2} \Omega$
- b)  $\frac{Z_0}{2} \Omega$
- c)  $\frac{Z_0 + Z_1}{2} \Omega$
- d)  $\frac{V_a}{I_a} \Omega$

15) An extra high voltage transmission line of length 300 km can be approximated by a lossless line having propagation constant  $\beta = 0.00127$  radians per km. Then the percentage ratio of line length to wavelength will be given by

- a) 24.24%
- b) 12.12%
- c) 19.05%
- d) 6.06%

16) A 3-phase transmission line is shown in the figure:



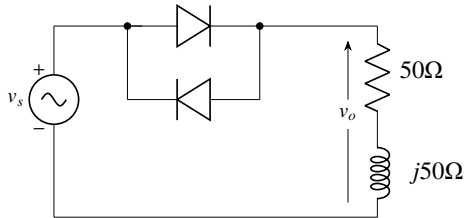
Voltage drop across the transmission line is given by the following equation:

$$\begin{bmatrix} \Delta V_a \\ \Delta V_b \\ \Delta V_c \end{bmatrix} = \begin{bmatrix} Z_s & Z_m & Z_m \\ Z_m & Z_s & Z_m \\ Z_m & Z_m & Z_s \end{bmatrix} \begin{bmatrix} I_a \\ I_b \\ I_c \end{bmatrix}$$

Shunt capacitance of the line can be neglected. If the line has positive sequence impedance of  $15 \Omega$  and zero sequence impedance of  $48 \Omega$ , then the values of  $Z_s$  and  $Z_m$  will be

- a)  $Z_s = 31.5 \, \Omega$ ;  $Z_m = 16.5 \, \Omega$
- b)  $Z_s = 26 \, \Omega$ ;  $Z_m = 11 \, \Omega$
- c)  $Z_s = 16.5 \, \Omega$ ;  $Z_m = 31.5 \, \Omega$
- d)  $Z_s = 11 \, \Omega$ ;  $Z_m = 26 \, \Omega$

17) In the single phase voltage controller circuit shown in the figure, for what range of triggering angle ( $\alpha$ ), the output voltage ( $v_o$ ) is not controllable?



- a)  $0^\circ < \alpha < 45^\circ$
- b)  $45^\circ < \alpha < 135^\circ$
- c)  $90^\circ < \alpha < 180^\circ$
- d)  $135^\circ < \alpha < 180^\circ$