GATE - 2008 - EE

EE1030 : Matrix Theory
Indian Institute of Technology Hyderabad

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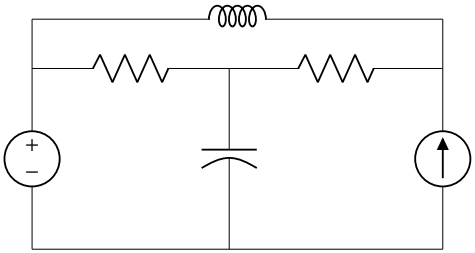
1) The number of chords in the graph of the given circuit will be



a) 3
b) 4
c) 5
d) 6

2) The Thevenin's equivalent of a circuit operating at $\omega = 5$ rad/s, has $V_{oc} = 3.71\angle -15.9°V$ 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 ϕ are constants, the output of the system will be of the form $Ke^{-\beta t}\sin(vt + \phi)$ where
   a) β need not be equal to α but v equal to ω
   b) v need not be equal to ω but β equal to α
   c) β equal to α and v is equal to ω
   d) β need not be equal to α and v need not be equal to ω

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

a) 0
b) $\frac{1}{8}$
c) $\frac{1}{4}$
d) $\frac{1}{2}$

5) The characteristic equation of a (3×3) 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

a) $\left(\mathbf{P}^2 + \mathbf{P} + \mathbf{2I}\right)$
b) $\left(\mathbf{P}^2 + \mathbf{P} + \mathbf{I}\right)$
c) $-\left(\mathbf{P}^2 + \mathbf{P} + \mathbf{I}\right)$
d) $-\left(\mathbf{P}^2 + \mathbf{P} + \mathbf{2I}\right)$

6) If the rank of a (5×6) matrix $\mathbf{Q}$ is 4, then which one of the following statements is correct?

a) $\mathbf{Q}$ will have four linearly independent rows and four linearly independent columns
b) $\mathbf{Q}$ will have four linearly independent rows and five linearly independent columns
c) $\mathbf{QQ}^{\intercal}$ will be invertible
d) $\mathbf{Q}^{\intercal}\mathbf{Q}$ will be invertible

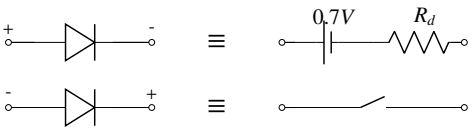
7) A function $y(t)$ satisfies the following differential equation:

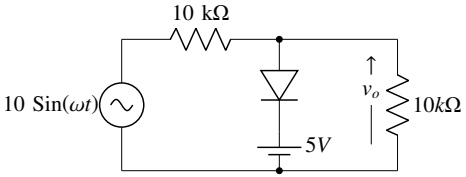
$$\frac{dy(t)}{dt} + y(t) = \delta(t)$$

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

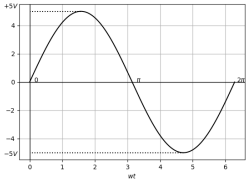
a) e^t
b) e^{-t}
c) $e^t u(t)$
d) $e^{-t} u(t)$

8) The equivalent circuits of a diode, during forward biased and reverse biased conditions, are shown in the figure

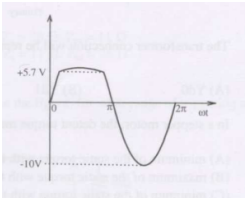




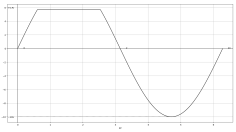
If such a diode is used in clipper circuit of figure given above, the output voltage (v_o) of the circuit will be



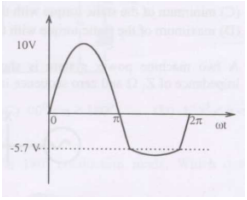
a)



b)



c)



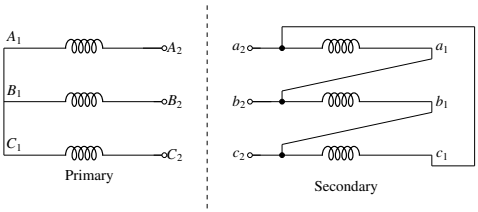
d)

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
   a) T_A, T_B
   b) $\frac{T_A}{2}, T_B$
   c) $T_A, \frac{T_B}{2}$
   d) $\frac{T_A}{2}, \frac{T_B}{2}$

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.

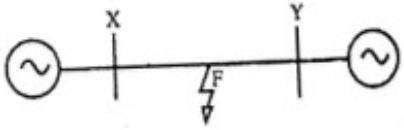
12) Three single-phase transformers are connected to form a 3-phase transformer bank. The transformers are connected in the following manner:



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.

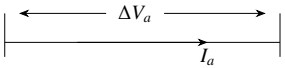
14) A two machine power system is shown below. Transmission line XY has positive sequence impedance of $Z_1\Omega$ and zero sequence impedance of $Z_0\Omega$.

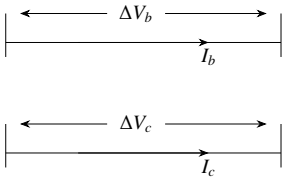


An 'a' phase to ground fault with zero fault impedance occurs at the centre of the transmission line. Bus voltage at X and line current from X to F for the phase 'a', are given by V_a Volts and I_a Amperes, respectively. Then, the impedance measured by the ground distance relay located at the terminal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





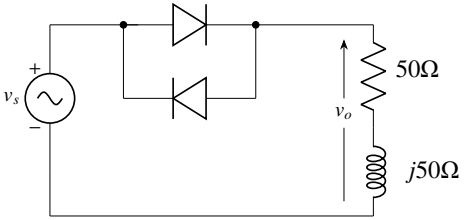
Voltage drop across the transmission line is given by the following equation:

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

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

a) Z_s = 31.5 Ω; Z_m = 16.5 Ω
b) Z_s = 26 Ω; Z_m = 11 Ω
c) Z_s = 16.5 Ω; Z_m = 31.5 Ω
d) Z_s = 11 Ω; Z_m = 26 Ω

17) In the single phase voltage controller circuit shown in the figure, for what range of triggering angle (α), the output voltage (v_0) is not controllable?



a) $0° < \alpha < 45°$
b) $45° < \alpha < 135°$
c) $90° < \alpha < 180°$
d) $135° < \alpha < 180°$