# ELECTRONICS & TELECOMMUNICATION ENGINEERING

## PAPER-I

1. In a silicon crystal, the arrangement of atoms repeats periodicity. This type of material is classified as
   a. Amorphous and non-crystalline
   b. Non-crystalline and epitaxial
   c. Epitaxial and single crystal
   d. Amorphous and single crystal

2. A conductor carries a current of 4 A and if magnitude second is of charge of an electron e = $1.6 \times 10^{-19}$ is Coulomb, then the number of electrons which flow past the cross-section per
   a. $2.5 \times 10^{-19}$
   b. $1.6 \times 10^{-19}$
   c. $6.4 \times 10^{-19}$
   d. $0.4 \times 10^{-19}$

3. The correct sequence of the following materials in the increasing order of conductivity is
   a. Silicon doped with boron - Silver - Aluminium - Intrinsic silicon
   b. Intrinsic silicon - Aluminium - Silver - Silicon doped with boron
   c. Aluminium - Intrinsic silicon - Silicon doped with boron - Silver
   d. Intrinsic silicon - Silicon doped with boron - Aluminium - Silver

4. Consider the following statements for an n-type semiconductor :
   1. Donor level ionization decreases with temperature
   2. Donor level ionization increases with temperature
   3. Donor level ionization is independent of temperature
   4. Donor level ionization increases as $E_D$ (donor energy level) moves towards the conduction band at a given temperature.

   Which of these statements is/are correct ?
   a. 1 only
   b. 2 only
   c. 2 and 4
   d. 3 only

5. Consider the following statements for an n-type semiconductor :
   1. $E_F$ lies below $E_D$ at a room temperature (T).
   2. $E_F$ lies above $E_D$ as $T \rightarrow 0$
   3. $E_F = E_D$ at some intermediate temperature
   4. $E_F$ is invariant with temperature.

   Where $E_F$ is Fermi energy and $E_D$ is donor level energy.

   Which of these statements is/are correct ?
   a. 1 and 2
   b. 2 and 3
   c. 1, 2 and 3
   d. 4 only

6. Which of the following materials are piezoelectric ?
   a. Mica and quartz
   b. Mica, barium titanate and quartz
   c. Mica and diamond
   d. Barium titanate and quartz

7. The correct sequence of the following materials in the increasing order of magnetic susceptibility is
   a. Diamagnetic - Ferromagnetic - Paramagnetic - Superconductor
   b. Ferromagnetic - Paramagnetic - Diamagnetic Superconductor
   c. Paramagnetic - Diamagnetic - Superconductor - Ferromagnetic
   d. Superconductor - Diamagnetic - Paramagnetic - Ferromagnetic

8. Match List I with List II and select the correct answer :

   List I (Dipole Characteristics)

   A. All dipoles have equal magnitude but are randomly oriented

B. 50% of the dipoles having equal magnitude are antiparallel to other 50% (having equal but lower magnitude)

C. 50% of the dipoles are antiparallel to other 50% but all have equal magnitude

D. All dipoles have equal magnitude but have parallel alignment

List II (Materials)

1. Ferri-magnetic
2. Anti-ferromagnetic
3. Ferro-magnetic
4. Para-magnetic

| | A | B | C | D |
|---|---|---|---|---|
| a. | 1 | 4 | 2 | 3 |
| b. | 4 | 1 | 3 | 2 |
| c. | 1 | 4 | 3 | 2 |
| d. | 4 | 1 | 2 | 3 |

9. Under the influence of an external electric field an insulator undergoes the process of polarization. There are four contributing factors to the total polarization viz. electronic. ionic, orientation and space charge At the optical frequencies, the only contribution to total polarization is from
   a. Space charge polarization
   b. Ionic polarization
   c. Orientation polarization
   d. Electronic polarization

10. Consider the following statements :

    A semiconductor to be used in optoelectronic devices should have

    1. direct energy band gap.
    2. indirect energy band gap.
    3. any value of forbidden energy band gap.
    4. right value of band gap corresponding to light wavelength

    Which of these statements is/are correct ?
    a. 1 only
    b. 1 and 4
    c. 2 and 3
    d. 2 and 4

11. An LED made using GaAs emits radiation in
    a. Visible region
    b. Ultraviolet region
    c. Infra red region
    d. Microwave frequency region

12. A resistance thermometer has a temperature coefficients of resistance $10^{-3}$ per degree and its resistance at 0°C is 1.0Ω. At what temperature is its resistance 1.1 Ω ?
    a. 10°C
    b. 100°C
    c. 120°C
    d. –10°C

13. The diffusion capacitance of a. p-n junction diode
    a. increases exponentially with forward bias voltage
    b. Decreases exponentially with forward bias voltage
    c. Decreases linearly with forward bias voltage
    d. Increases linearly with forward bias voltage

14. The reverse current of a silicon diode is
    a. Highly bias voltage sensitive
    b. Highly temperature sensitive
    c. Both bias voltage and temperature sensitive
    d. Independent of bias voltage and temperature

15. A combination of two diodes connected in parallel when compared to a single diode can withstand
    a. Twice the value of peak inverse voltage
    b. Twice the value of maximum forward current
    c. A larger leakage current
    d. Twice the value of cut-in voltage

16. Assume $n_i = 1.45 \times 10^{10}/cm^3$ for silicon. In an n-type silicon sample, the donor concentration at 300 K is $5 \times 10^{14}/cm^3$ and corresponds to 1 impurity atom for $10^8$ silicon atoms. The electron and hole concentrations in the sample will be
    a. $n = 5 \times 10^{14}/cm^3$ and $p = 4.2 \times 10^5/cm^3$
    b. $n < 5 \times 10^{14}/cm^3$ and $p > 4.2 \times 10^5/cm^3$
    c. $n > 5 \times 10^{14}/cm^3$ and $p < 4.2 \times 10^5/cm^3$
    d. $n < 5 \times 10^{14}/cm^3$ and $p < 4.2 \times 10^5/cm^3$

17. The resistivity at room temperature of intrinsic silicon is $2.3 \times 10^3$ Ωm and that of en n-type extrinsic silicon sample is $8.33 \times 10^{-2}$ Ωm. A bar of this extrinsic silicon sample is 3 mm long and has a rectangular cross-section 50 × 100 mm and a steady current of 1 μA exists in the bar. The voltage across the bar is found to be 50 mV. If the same bar is of intrinsic silicon, the voltage across the bar will be about
    a. 1400 V
    b. 140 V
    c. 14 V
    d. 1.4V

18. A semiconductor specimen of breadth d, width w and carrying current *I* is placed in a magnetic field B to develop Hall voltage $V_H$ in a direction perpendicular to *I* and B. $V_H$ is NOT proportional to
    a. B
    b. *I*
    c. 1/w
    d. 1/d

19. In switching diode fabrication, a dopant is introduced into silicon which introduces additional trap levels in the material thereby reducing the mean life time of carriers. This dopant is
    a. Aluminium
    b. Platinum
    c. Gold
    d. Copper

20. The light emitting diode (LED) emits light of a particular colour because
    a. It is fabricated from a fluoroscent material
    b. Transition between energy levels of the carriers takes place while crossing the p-n junction
    c. Heat generated in the diode is converted into light
    d. The band gap of the semi-conductor material used in the fabrication of the diode is equal to the energy $h_v$ of the light photon

21. Depletion capacitance in a diode depends on
    1. Applied junction voltage
    2. Junction built-in potential.
    3. Current through junction
    4. Doping profile across the junction

    Select the correct answer using the codes given below :
    a. 1 and 2
    b. 1 and 3
    c. 1, 2 and 4
    d. 2, 3 and 4

22. The depletion region in a semiconductor p-n junction diode has
    a. Electrons and holes
    b. Positive and negative ions on either side
    c. Neither electrons nor ions
    d. No holes

23. When a junction diode is used in switching applications, the1orward recovery time is
    a. Of the order of the reverse recovery time
    b. Negligible in comparison to the reverse recovery time
    c. Greater than the reverse recovery time
    d. Equal to the mean carrier life time τ for the excess minority carriers

24. The Gunn diode is made from
    a. Silicon
    b. Germanium
    c. Gallium Arsenide
    d. Selenium

25. The internal resistance of a current source used in the. model of BJT while analyzing a circuit using BJT is
    a. Very high
    b. Very low
    c. Zero
    d. Of the order of a few mega-ohms

26. For a BJT in common emitter mode, base to emitter capacitance ($C_\pi$) is ten times the collector to base capacitance (C). Transistor is biased at quiescent collector current $I_{CQ}$ = 1 mA and its short circuit unity gain frequency is 0.909 M (rad/s). What is the $C_\pi$ Value ?
    a. 6.45 nF
    b. 44 nF
    c. 40 nF

d. 7.1 nF

27. A bipolar junction transistor has a common base forward short circuit current gain of 0.99. Its common emitter forward short circuit current gain will be
   a. 50
   b. 99
   c. 100
   d. 200

28. The scaling factor of an MOS device is $\alpha$. Using constant voltage scaling model, the gate area of the device will be scaled as
   a. $1/\alpha$
   b. $1/\alpha^2$
   c. $1/\alpha^3$
   d. $1/\alpha^4$

29. A CMOS amplifier when compared to an N-channel MOSFET, has the advantage of
   a. Higher cut-off frequency
   b. Higher voltage gain
   c. Higher current gain
   d. Lower current drain from the power supply, thereby less dissipation

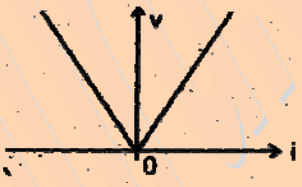
30. In the forward blocking region of a silicon controlled rectifier, the SCR is
   a. In the off-state
   b. In the on-state
   c. Reverse biased
   d. At the point of breakdown

31. In fabricating silicon BJT in ICs by the expitaxial process, the number of diffusions used is usually
   a. 2
   b. 3
   c. 4
   d. 6

32. In the fabrication of n-p-n transistor in an IC, the buried layer on the p-type substrate is
   a. $P^+$-doped
   b. $n^+$-doped
   c. Used to reduce the parasitic capacitance
   d. Located in the emitter region

33. Velocity of light travelling in an optical fibre is
   a. Equal to c
   b. Greater than c by a few per cent Less than c by a few per cent
   c. Much greater than c, approaching the magnitude of $C^2$

34. In an opto-electronic communication system, the system component in which free electrons are involved in its operation is
   a. Laser
   b. Optical fibre
   c. Photo detector
   d. Coupling device employed with the optical fibre

35. 

The v-i characteristic of an element is shown in the above figure. The element is
   a. Non-linear, active, non-bilateral
   b. Linear, active, non-bilateral
   c. Non-linear, passive, non-bilateral
   d. Non-linear, active, bilateral

36. The sum of two or more arbitrary sinusoids is
   a. Always periodic
   b. Periodic under certain conditions
   c. Never periodic
   d. Periodic only if all the sinusoids are identical in frequency and phase

37. The average value of the full-wave rectified sine wave with period $\pi$, and a peak value of $V_m$ is
   a. 0.707 $V_m$
   b. 0.500 $V_m$
   c. 0.637 $V_m$
   d. 0.318 $V_m$

38. Match List I with List II and select the correct answer:
   List I
   A. Free and Forced response
   B. Z-transforms
   C. Probability theory
   D. Fourier series
   List II

1. Discrete time systems
2. Dirichlet conditions
3. Non-homogeneous differential equation
4. Random processes

| | A | B | C | D |
|---|---|---|---|---|
| a. | 1 | 3 | 2 | 4 |
| b. | 3 | 1 | 2 | 4 |
| c. | 1 | 3 | 4 | 2 |
| d. | 3 | 1 | 4 | 2 |

39. The relationship between the input x(t) and the output y(t) of a system is

$$\frac{d^2y}{dt^2} = x(t-2)u(t-2) + \frac{d^2x}{dt^2}$$

The transfer function of the system is

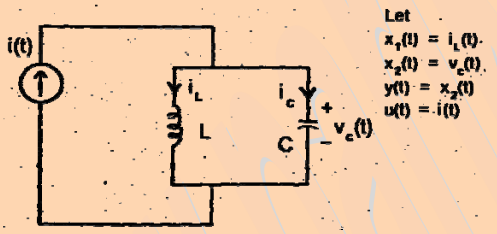
a. $1+\frac{s^2}{e^{2s}}$

b. $1+\frac{e^{-2s}}{s^2}$

c. $1+\frac{e^{2s}}{s^2}$

d. $1+\frac{s^2}{e^{-2s}}$

40.




Which one of the following is the state-space model of the circuit shown above?

a. $\begin{bmatrix} x_1(t) \\ x_2(t) \end{bmatrix} = \begin{bmatrix} 0 & \frac{1}{L} \\ -\frac{1}{C} & 0 \end{bmatrix} \begin{bmatrix} x_1(t) \\ x_2(t) \end{bmatrix} + \begin{bmatrix} 0 \\ \frac{1}{C} \end{bmatrix} u(t)$

$$y(t) = \begin{bmatrix} 0 & 1 \end{bmatrix} \begin{bmatrix} x_1(t) \\ x_2(t) \end{bmatrix}$$

b. $\begin{bmatrix} x_1(t) \\ x_2(t) \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ -\frac{1}{C} & -\frac{1}{L} \end{bmatrix} \begin{bmatrix} x_1(t) \\ x_2(t) \end{bmatrix} + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u(t)$

$$y(t) = \begin{bmatrix} 0 & 1 \end{bmatrix} \begin{bmatrix} x_1(t) \\ x_2(t) \end{bmatrix}$$

c. $\begin{bmatrix} x_1(t) \\ x_2(t) \end{bmatrix} = \begin{bmatrix} 0 & \frac{1}{L} \\ -\frac{1}{C} & 0 \end{bmatrix} \begin{bmatrix} x_1(t) \\ x_2(t) \end{bmatrix} + \begin{bmatrix} 1 \\ 0 \end{bmatrix} u(t)$

$$y(t) = \begin{bmatrix} 1 & 0 \end{bmatrix} \begin{bmatrix} x_1(t) \\ x_2(t) \end{bmatrix}$$

d. $\begin{bmatrix} x_1(t) \\ x_2(t) \end{bmatrix} = \begin{bmatrix} 0 & \frac{1}{L} \\ -\frac{1}{C} & 0 \end{bmatrix} \begin{bmatrix} x_1(t) \\ x_2(t) \end{bmatrix} + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u(t)$

$$y(t) = \begin{bmatrix} 1 & 0 \end{bmatrix} \begin{bmatrix} x_1(t) \\ x_2(t) \end{bmatrix}$$

41. With the conventional notation X = AX + BU for the state description of a linear time-invariant network, examine the validity of the following statements relating to the matrix A:

1. A is symmetrical if the network is reciprocal.
2. The sum of the natural frequencies of the network is equal to the determinant of A.

Which of these statements is/are true ?

a. Both 1 and 2

b. 1 only

c. 2 only

d. Neither 1 nor 2

42. Which one of the following is NOT a correct statement about the state-space model of a physical system ?

a. State-space model can be obtained only for a linear system

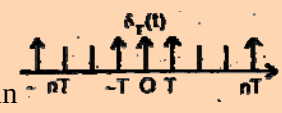
b. Eigen values of the system represent the roots of the characteristic equation

c. X = AX + Bu represents linear state-space model of a physical system

d. X(t) represents the state vector of the system

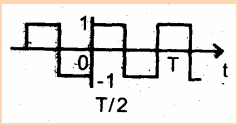
43. Match List I (Nature of Periodic Function) with List II (Properties of Spectrum Function) and select the correct answer :

List I

A. Impulse train 


B. Full-wave rectified sine function

C. Sin 2πt/6 cos 2πt/6

D. 


List II

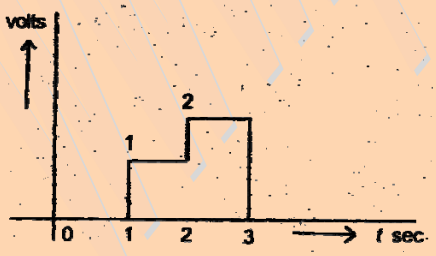
1. Only even harmonics are present
2. Impulse train with strength 1/T
3. $\alpha_3 = 1/2j$ ; $\alpha_{-3} = -1/2j$ ; $\alpha_1 = -1/2j$ ; $\alpha_{-1} = 1/2j$
4. Only odd harmonics are present
5. Both even and odd harmonics are present

| | A | B | C | D |
|---|---|---|---|---|
| a. | 5 | 2 | 3 | 4 |
| b. | 2 | 1 | 4 | 3 |
| c. | 5 | 2 | 4 | 3 |
| d. | 2 | 1 | 3 | 4 |

44. The covariance function of a band limited white noise is
   a. A Dirac delta function
   b. An exponentially decreasing function
   c. A sinc function
   d. A $sinc^2$ function

45. The inverse Fourier transform of δ(f) is
   a. u(t)
   b. 1
   c. δ(t)
   d. $e^{j2\pi t}$

46. If $\left(\frac{27s+97}{s^2+33s}\right)$ is the Laplace transform of f(t), then $f(0^+)$ is
   a. Zero
   b. 97/33
   c. 27
   d. infinity

47. 


The Laplace transform of the waveform shown in the above figure is
   a. $1/s\ [e^s + e^{2s} + 2e^{3s}]$
   b. $1/s\ [e^s + e^{2s} + 2e^{-3s}]$
   c. $1/s\ [e^{-s} + e^{-2s} + 2e^{-3s}]$
   d. $1/s\ [e^{-s} + e^{-2s} - 2e^{-3s}]$

48. Match List I (F(s)) with List II (f(t)) and select the correct answer:

List I

A. $\frac{10}{s(s+10)}$

B. $\frac{10}{(s^2+100)}$

C. $\frac{(s+10)}{(s+10)^2+100}$

D. 10

List II

1. $10\,\delta(t)$.
2. $(e^{-10t} \cos 10\,t)\,.\,u(t)$
3. $(\sin 10\,t)\,.\,u(t)$
4. $(1 - e^{-10t})\,.\,u(t)$

| | A | B | C | D |
|---|---|---|---|---|
| a. | 3 | 4 | 1 | 2 |
| b. | 4 | 3 | 1 | 2 |
| c. | 3 | 4 | 2 | 1 |
| d. | 4 | 3 | 2 | 1 |

49. The Laplace transform of sin ωt is
   a. $\frac{s}{s^2+\omega^2}$
   b. $\frac{\omega^2}{s^2+\omega^2}$
   c. $\frac{s^2}{s^2+\omega^2}$
   d. $\frac{\omega}{s^2+\omega^2}$

50. Given, $£\ f(t) = F(s) = \int_0^\infty f(t)e^{-st}.dt$ which of the following expressions are correct?
   1. $£\left[f(t-a)u(t-a)\right] = F(s)e^{-sa}$
   2. $£\,tf(t) = \frac{-dF(s)}{ds}$
   3. $£\,(t-a)\,f(t) = as\ F(s)$
   4. $£\frac{df(t)}{dt} = s\,F(s) - f(0_+)$

Select the correct answer using the codes given below:
   a. 1, 2 and 3
   b. 1, 2 and 4

c. 2, 3 and 4

d. 1, 3 and 4

51. Two rectangular waveforms of duration $T_1$ and $T_2$ seconds are convolved. What is the shape of the resulting waveform?

a. Triangular

b. Rectangular

c. Trapezoidal

d. Semi-circular

52. A discrete LTI system is non-causal if its impulse response is

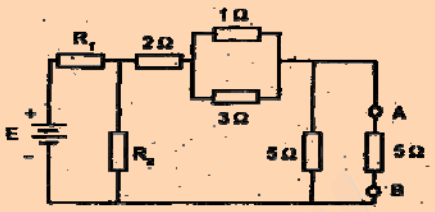
a. $a^n\, u(n-2)$

b. $a^{n-2}\, u(n)$

c. $a^{n+2}\, u(n)$

d. $a^n\, u(n+2)$

53.




In the circuit shown above, the voltage across 2Ω resistor is 20 V. The 5Ω resistor connected between the terminals A and B can be replaced by an ideal

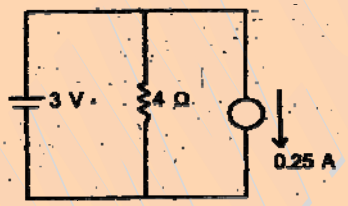
a. Voltage source of 25 V with + terminal upward

b. Voltage source of 25 V with + terminal downward

c. Current source of 2 A upward

d. Current source of 2 A downward

54.




The current flowing through the voltage source in the above circuit is

a. 1.0 A

b. 0.75 A

c. 0.5 A

d. 0.25 A

55. The number of edges in a compete graph of n vertices is

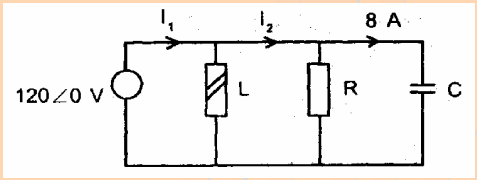
a. $n(n-1)$

b. $\frac{n(n-1)}{2}$

c. $n$

d. $n-1$

56.




In the above circuit, if $|I_1| = |I_2| = 10$ A

a. $I_1$ will lead by $\tan^{-1}$ 8/6, $I_2$ will lag by $\tan^{-1}$ 8/6

b. $I_1$ will lead by $\tan^{-1}$ 6/8, $I_2$ will lag by $\tan^{-1}$ 6/8

c. $I_1$ will lead by $\tan^{-1}$ 8/6, $I_2$ will lag by $\tan^{-1}$ 8/6

d. $I_1$ will lead by $\tan^{-1}$ 6/8, $I_2$ will lag by $\tan^{-1}$ 6/8

57. A two port network is reciprocal, if and only if

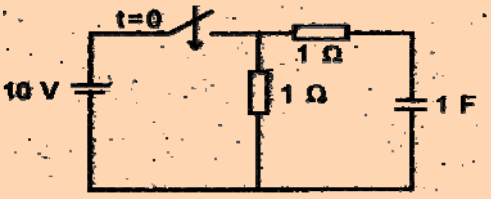
a. $Z_{11} = Z_{22}$

b. $BC - AD = -1$

c. $Y_{12} = -Y_{21}$

d. $h_{12} = h_{21}$

58.




In the circuit shown above, the switch is closed at. t = 0. The current through the capacitor will decrease exponentially with a time constant

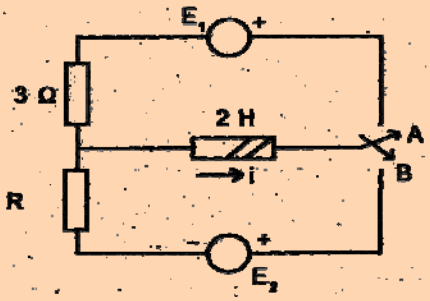
a. 0.5 s

b. 1 s

c. 2 s

d. 10 s

59.



In the circuit shown above, the switch is moved from position A to B at time t = 0. The current i through the inductor satisfies the following conditions

1. i(0) = –8A
2. di/dt (t = 0) = 3A/s
3. I(∞) = 4A

The value of R is

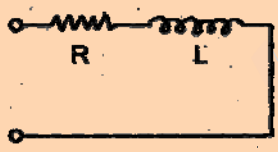
a. 0.5 ohm
b. 2.0 ohm
c. 4.0 ohm
d. 12 ohm

60. In a circuit the voltage across an element is $v(t) = 10(t - 0.01)e^{-100t}$ V. The circuit is

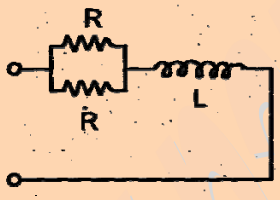
a. Undamped
b. Under damped
c. Critically damped
d. Over damped

61.

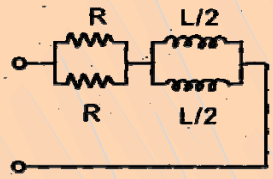
1.



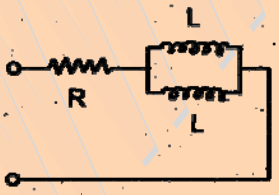

2.




3.



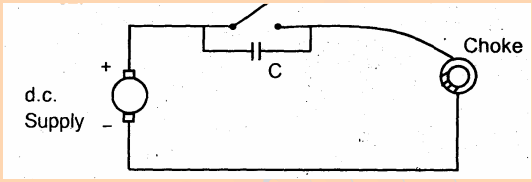

4.




The correct sequence of the time constants of the circuits shown above in the increasing order is

a. 1 – 2 – 3 – 4
b. 4 – 1 – 2 – 3
c. 4 – 3 – 1 – 2
d. 4 – 3 – 2 – 1

62.




An iron-cored choke of large inductance is connected to a d.c. supply as shown in the above circuit. A capacitor C is also connected across the switch. The role of C is to

a. Improve the power factor of the circuit
b. Minimize the current drawn from supply
c. Prevent the arcing across switching under switching conditions
d. Increase the magnetic flux in the core

63. Bartlett's bisection theorem holds for which one of the following terminal networks?

a. Reciprocal network
b. Balanced network
c. Symmetric network
d. Non-linear network

64. Match List I with List II and select the correct answer:

List I

A. Internal impedance of an. ideal current source is
B. For attenuated natural oscillations, the poles of the transfer function must lie on the
C. A battery with an e.m.f. E and internal resistance R delivers current to a load $R_L$. Maximum power transferred is
D. The roots of the characteristic equation give

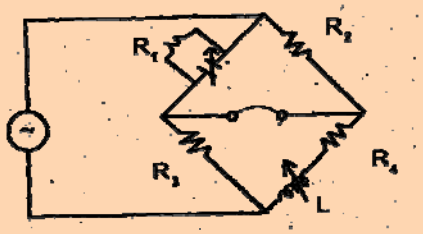
List II

1. Forced response of the circuit
2. Natural response of the circuit
3. $E^2/4R$
4. $E^2/2R$
5. Left hand part of the complex frequency plane
6. Right hand part of the complex frequency plane

7. Infinite
8. Zero.

| | A | B | C | D |
|---|---|---|---|---|
| a. | 7 | 6 | 3 | 1 |
| b. | 8 | 5 | 4 | 2 |
| c. | 8 | 6 | 4 | 1 |
| d. | 7 | 5 | 3 | 2 |

65.




In Maxwell bridge as shown above, the value of C and its shunting resistance $R_1$ are unknown. The bridge balance relations are $Z_1/Z_3 = Z_2/Z_4$. The values of C and $R_1$ are

a. $C = L/R_2R_3$, $R_1 = R_2R_3/R_4$
b. $C = L/R_3R_4$, $R_1 = R_4/R_2R_3$
c. $C = LR_2/R_3$, $R_1 = R_3/R_2R_4$
d. $C = LR_3/R_2$, $R_1 = R_3/R_2R_4$

66. In the pass-band of a symmetric lattice filter, the nature of $X_A$ and $X_B$, where $X_A$ and $X_B$ represent the reactances of the series, arm and the diagonal arm of the lattice is of

a. The same sign
b. The opposite sign
c. The same sign and equal magnitude
d. Of arbitrary sign

67. Match List I (Quantities) with List II (Units) and select the correct answer :

List I

A. R/L
B. 1/ LC
C. CR
D. $\sqrt{L/C}$

List II

1. Second
2. Ohm
3. $(\text{Radian/Second})^2$
4. $(\text{Second})^{-1}$

| | A | B | C | D |
|---|---|---|---|---|
| a. | 4 | 3 | 1 | 2 |
| b. | 3 | 4 | 2 | 1 |
| c. | 4 | 3 | 2 | 1 |
| d. | 3 | 4 | 1 | 2 |

68. An electric charge Q is placed in a dielectric medium. Which of the following quantities are independent of the dielectric constant $\in$ of the medium ?

a. Electric potential V and Electric field intensity E
b. Displacement density D and Displacement $\Psi$
c. Electric field intensity E and Displacement density D
d. Electric potential V and Displacement $\Psi$

69. Two coaxial cylindrical sheets of charge are present in free space, $\rho_s = 5\ C/m^2$ at r = 2 m and $\rho_s = -2\ C/m^2$ at r = 4 m. The displacement flux density $\overline{D}$ at r = 3 m is

a. $\overline{D} = 5\bar{a}_r\ \ C/m^2$
b. $\overline{D} = 2/3\bar{a}_r\ \ C/m^2$
c. $\overline{D} = 10/3\bar{a}_r\ \ C/m^2$
d. $\overline{D} = 18/3\bar{a}_r\ \ C/m^2$

70. Two thin parallel wires are carrying current along the same direction. The force experienced by one due to the other is

a. Parallel to the lines
b. Perpendicular to the lines and attractive
c. Perpendicular to the lines and repulsive
d. Zero

71. An electric potential field is produced in air by point charges 1 μC and 4 μC located at (–2, 1, 5) and (1, 3, –1) respectively. The energy stored in the field is

a. 2.57 mJ
b. 5.14 mJ
c. 10.28 mJ
d. 12.50 mJ

72. Which one of the following potentials does NOT satisfy Laplace's Equation ?

a. $V = 10\ xy$
b. $V = r\cos\phi$
c. $V = 10/r$
d. $V = \rho\cos\phi + 10$

73. Laplacian of a scalar function V is

a. Gradient of V
b. Divergence of V
c. Gradient of the gradient of V
d. Divergence of the gradient of V

74. Match List I (Dominant Mode of Propagation) with List II (Type of Transmission Structure) and select the correct answer:

List I

A. Coaxial line
B. Rectangular waveguide
C. Microstrip line
D. Coplanar waveguide

List II

1. TE
2. Quasi TEM
3. Hybrid
4. TEM

| | A | B | C | D |
|---|---|---|---|---|
| a. | 1 | 4 | 2 | 3 |
| b. | 4 | 1 | 3 | 2 |
| c. | 1 | 4 | 3 | 2 |
| d. | 4 | 1 | 2 | 3 |

75. In a line the VSWR of a load is 6 dB. The reflection coefficient Will be
a. 0.033
b. 0:33
c. 0.66
d. 3.3

76. $Z_L = 200\ \Omega$ and it is desired that $Z_i = 50\Omega$. The quarterwave transformer should have a characteristic impedance of
a. 100 Ω
b. 40 Ω
c. 10,000 Ω
d. 4 Ω

77. A TEM wave impinges obliquely on a dielectric- dielectric boundary ($\in r_1 = 2$, $\in r_2 = 1$). The angle of incidence for total reflection is
a. 30°
b. 45°
c. 60°
d. 75°

78. A plane electromagnetic wave travelling in a perfect dielectric medium of characteristic impedance $\eta_1$ is incident normally on its boundary with another perfect dielectric medium of characteristic impedance $\eta_2$. The electric and magnetic field strengths of the incident wave are denoted. by $E_i$ and $H_i$ respectively whereas $E_r$ and $H_r$ denote these quantities for the reflected wave, and $E_t$ and $H_t$ for the transmitted wave.

Which of the following relations are correct ?

1. $E_i = \eta_1 H_i$
2. $E_r = \eta_1 H_r$
3. $E_t = \eta_2 H_t$

Select the correct answer using the codes given below:

a. 1, 2 and 3
b. 1 and 2
c. 1 and 3
d. 2 and 3

79. A plane electromagnetic wave travelling in a perfect dielectric medium of dielectric constant $\in_1$ is incident on its boundary with another perfect dielectric medium of dielectric constant $\in_2$. The incident ray makes an angle of $\theta_1$ with the normal to the boundary surface. The ray transmitted into the other medium makes an angle of $\theta_2$ with the normal. If $\in_1 = 2\in_1$ and $\theta_1 = 60^0$, which one of the following is correct?
a. $\theta_2 = 45^0$
b. $\theta_2 = \sin^{-1}\ 0.433$
c. $\theta_2 = \sin^{-1} 0.612$
d. There will be no transmitted wave

80. In a. four element Yagi-Uda antenna
a. There is one driven element, one director and two reflectors
b. There is one driven element, two directors and one reflector
c. There are two driven elements, one director and two reflectors
d. All the four elements are driven elements

81. Which one of the following Maxwell's equations gives the basic idea of radiation?
a. $\left.\begin{aligned}\nabla \times H = \partial D/\partial t \\ \nabla \times E = -\partial B/\partial t\end{aligned}\right\}$

b. $\left.\begin{array}{l}\nabla \times E = -\partial B / \partial t \\ \nabla . D = 0\end{array}\right\}$

c. $\left.\begin{array}{l}\nabla . D = \rho \\ \nabla . B = 0\end{array}\right\}$

d. $\left.\begin{array}{l}\nabla . B = 0 \\ \nabla \times H = (\partial D / \partial t)\end{array}\right\}$

82. For TE or TM modes of propagation in bounded media, the phase velocity
   a. Is independent of frequency
   b. Is a linear function of frequency
   c. Is a non-linear function of frequency
   d. Can be frequency-dependent or frequency independent depending on the source

83. A waveguide operated below cut-off frequency can be used as
   a. A phase shifter
   b. An attenuator
   c. An isolator
   d. None of the above

84. Match List I (Nature of Polarization) with List II (Relationship Between X and Y Components) for a propagating wave having cross-section in the XY plane and propagating along Z-direction and select the correct answer :

List I

A. Linear

B. Left circular

C. Right circular

D. Elliptical

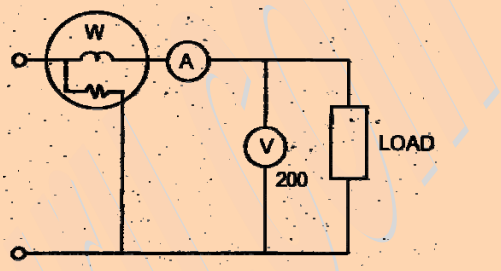
List II

1. X and Y components are in same phase
2. X and Y components have arbitrary phase difference
3. X component leads Y by $90^0$
4. X component lags behind Y by 90°

| | A | B | C | D |
|---|---|---|---|---|
| a. | 1 | 4 | 2 | 3 |
| b. | 4 | 1 | 2 | 3 |
| c. | 1 | 4 | 3 | 2 |
| d. | 4 | 1 | 3 | 2 |

85. An air condenser of capacitance of 0.005 μF is connected to a d.c. supply of 500 Volts, disconnected and then immersed in oil with a dielectric constant of 2.5. Energy stored in the capacitor before and after immersion, respectively is
   a. $500 \times 10^{-4}$ Joules and $250 \times 10^{-4}$ Joules
   b. $250 \times 10^{-4}$ Joules and $500 \times 10^{-4}$ Joules
   c. $625 \times 10^{-4}$ Joules and $250 \times 10^{-4}$ Joules
   d. $250 \times 10^{-4}$ Joules and $625 \times 10^{-4}$ Joules

86.




Consider the following data for the circuit shown above :

Ammeter : Resistance 0.2 Ω Reading 5.0A

Voltmeter : Resistance 2kΩ Reading 200V

Wattmeter : Current coil resistance 0.2 Ω,

Pressure coil resistance 2 k Ω

Load : Power factor = 1

The reading of the Wattmeter is
   a. 980 W
   b. 1000 W
   c. 1005 W
   d. 1010 W

87. Force developed by an electromagnet is given as

$$F = \mu^a B^b A^c$$

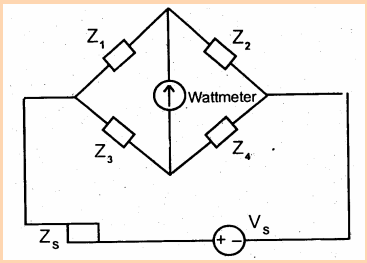
where μ = permeability of air in the gap

B = flux density in the air gap

A = cross-sectional area of the gap

Then a, the values of b and c are respectively
   a. 1, 1 and 2
   b. –1, 1 and –2
   c. 1, 2 and –1
   d. –1, 2 and 1

88.



Consider the circuit as shown above. $Z_1$ is an unknown impedance and measured as $Z_1 = (Z_2Z_3)/Z_4$. The uncertainties in the value of $Z_2$, $Z_3$ and $Z_4$ are ±1%, ±1% and ±3% respectively. The overall uncertainty in the measured value of $Z_1$ is

a. $\sqrt{11}\%$
b. ± 4%
c. ±5%
d. $\sqrt{5}\%$

89. The measured value of a capacitor is 100μF. The true value of the capacitor is 110μF. The percentage relative error is

a. 9.99%
b. 9.09%
c. 10.0%
d. 4.76%

90. The X and Y inputs to a CRC are respectively 10 cos (100 t + ϕ) and 10 sin (100 t + ϕ). The resulting Lissajous pattern is

a. A straight line inclined at an angle ϕ
b. A horizontal line
c. An ellipse with axis making an angle ϕ
d. A circle

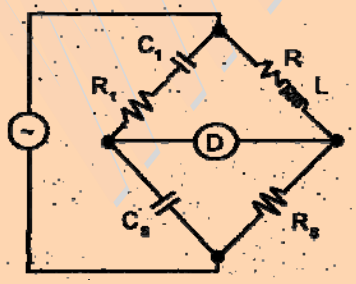
91. For the measurement of the voltage of the order of mV, the voltmeter used is

a. Rectifier-amplifier type VTVM
b. Amplifier-rectifier type VTVM.
c. Diode peak reading voltmeter
d. Slide wire VTVM

92. Wagner's earthing device is used in a.c. bridges for eliminating the effect of

a. Stray electrostatic field
b. Intercomponent capacitances
c. Earth capacitance
d. All the above three

93.




For the Owen-bridge circuit shown above, when balanced, the values of L and R are

a. $L = C_SR_S / R_1$, $R = R_SC_S/C_1$
b. $L = C_SR_S R_1$, $R = R_SC_S/C_1$
c. $L = C_1R_SR_1$, $R = R_SC_SC_1$
d. $L = C_S/C_1 R_SR_1$, $R = R_1C_S/C_1$

94. Match List I with List II and select the correct answer:

List I (Instrument)

A. Vibration Galvanometer
B. Head phone
C. D'Arsonval Galvanometer
D. C.R.C.

List II (Frequency)

1. 100 Hz
2. Zero Hz
3. 1 kHz
4. Large frequency range

| | A | B | C | D |
|---|---|---|---|---|
| a. | 2 | 3 | 1 | 4 |
| b. | 1 | 4 | 2 | 3 |
| c. | 2 | 4 | 1 | 3 |
| d. | 1 | 3 | 2 | 4 |

95. Consider the following statements :

1. A variable capacitance type transducer, gives an output proportional to acceleration
2. LVDT is a self-governing type of transducer.
3. Eddy current type of transducer gives an output proportional to velocity
4. A piezoelectric transducer cannot be used to measure static variables

Which of these statements is/are correct ?

a. 1 and 2
b. 1, 2 and 3
c. 2 and 4
d. 4 only

96. A temperature between –200°C and 1000°C may be measured conveniently by

a. Thermistor
b. Resistance thermometer
c. Optical pyrometer
d. Copper-constantan thermocouple

97. A hot-wire anemometer is a device used to measure

a. Gas velocities
b. Pressure in gases
c. Liquid discharge
d. Temperature

98. Very small displacements are effectively measured using
a. LVDT
b. Strain gauge
c. Thermistor
d. Tachogenerator

99. Experiments conducted With ultraviolet light of wavelength $1.800 \times 10^{-5}$ cm show that electrons of maximum energy 1.51 eV are ejected from a certain metal. If Planck's constant is $6.62 \times 10^{-27}$ erg.sec., the photoelectric threshold of the metal is about
a. 3.4 eV
b. 4.8 eV
c. 5.4 eV
d. 5.0 eV

100. In a PCM system of telemetry, the quantization noise depends on
a. The sampling rate and quantization levels
b. The sampling rate only
c. The number of quantization levels only
d. Information provided is not sufficient

101. The bandwidth requirement of an FM telemetry channel is
a. Smaller than that of an AM telemetry channel
b. Equal to that of an AM telemetry channel
c. About ten times that of an AM telemetry channel
d. About 100 times that of an AM telemetry channel

102. Consider the following statements :
In a metal
1. $d\sigma/dT$ is positive at very low temperatures.
2. $d\sigma/dT$ is negative at very high temperatures.
3. $d\sigma/dt \rightarrow 0$ at some intermediate temperatures.
4. $\sigma$ is independent of temperature

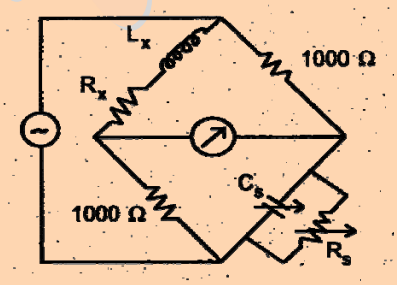
where $\sigma$ is the electrical conductivity and T is the temperature.

Which of these statements is/are correct ?
a. 1 and 2
b. 1 and 3
c. 1, 2 and 3
d. 4 only

103. Even though carbon is in the IV group of the Periodic Table, it is not used as a semiconductor because it has
a. High dielectric constant
b. Large energy gap > 5 eV
c. Low temperature coefficient
d. Low thermal conductivity

104. Harmonic distortion analyser is an instrument used to
a. Measure the amplitude of each harmonic component individually
b. Measure the r.m.s. value of amplitudes of all harmonics simultaneously
c. Measure the signal levels of each harmonic of an unknown waveform
d. Display the value of amplitude of each harmonic on the C.R.O. screen

105.




In the bridge circuit shown above, at balance condition, the value of $C_s = 0.5\ \mu F$ and $R_s = 1000\ \Omega$. The values of inductance $L_x$ and resistance $R_x$ are
a. $L_x = 0.5$ H, $R_x = 1000\ \Omega$
b. $L_x = 0.25$ H, $R_x = 2000\ \Omega$
c. $L_x = 0.5$ H, $R_x = 3000\ \Omega$
d. $L_x = 0.25$ H, $R_x = 500\ \Omega$

106. Assertion (A) : Every material has a different value of energy band gap except metals which have no band gap.
Reason (R) : The energy band gap is decided by the equilibrium lattice constant which is different in different materials.

a. Both A and R are individually true and R is the correct explanation of A
b. Both A and R are individually true but R is not the correct explanation of A
c. A is true but R is false
d. A is false but R is true

107. Assertion (A) : The conductivity of a semiconductor is decided by the level of its doping and is almost independent of its band gap value irrespective of temperature.

Reason (R) : The carrier concentration due to doping is independent of temperature, if it is not too low.

a. Both A and R are individually true and R is the correct explanation of A
b. Both A and R are individually true but R is not the correct explanation of A
c. A is true but R is false
d. A is false but R is true

108. Assertion (A) : In a transistor the thickness of the base region is kept as small as possible.

Reason (R) : By keeping the base thickness small, a large electric field is produced between the emitter and the collector which makes the transistor fast-acting.

a. Both A and R are individually true and R is the correct explanation of A
b. Both A and R are individually true but R is not the correct explanation of A
c. A is true but R is false
d. A is false but R is true

109. Assertion (A) : A drift transistor exhibits better high-frequency response as compared to a diffusion transistor, when both the transistors have identical base, collector and emitter geometries.

Reason (R) : The transport of minority carriers in the base region of a drift transistor is by the drift process, whereas that in a diffusion transistor is by the diffusion process.

a. Both A and R are individually true and R is the correct explanation of A
b. Both A and R are individually true but R is not the correct explanation of A
c. A is true but R is false
d. A is false but R is true

110. Assertion (A) : A periodic function satisfying Dirichlet conditions can be expanded into Fourier series.

Reason (R) : A periodic function can be reconstructed from $\frac{a_0}{2}+\sum_{n=1} a_n \cos n\omega_0 t + \sum_{n=1} b_n \sin n\omega_0 t$ for very lage n, excluding infinity.

a. Both A and R are individually true and R is the correct explanation of A
b. Both A and R are individually true but R is not the correct explanation of A
c. A is true but R is false
d. A is false but R is true

111. Assertion (A) : In the exponential Fourier representation of a real-valued periodic function $f(t)$ of frequency $f_0$, the coefficients of the terms $e^{j2\pi nf_0 t}$ and $e^{-j2\pi nf_0 t}$ are negatives of each other.

Reason (R) : The discrete magnitude spectrum of $f(t)$ is even and the phase spectrum is odd.

a. Both A and R are individually true and R is the correct explanation of A
b. Both A and R are individually true but R is not the correct explanation of A
c. A is true but R is false
d. A is false but R is true

112. Assertion (A) : Kirchoff's voltage law states that in a closed path in a network, the algebraic sum of all voltages in a single direction is zero.

Reason (R) : Law of conservation of charge is the basis of this law.

a. Both A and R are individually true and R is the correct explanation of A
b. Both A and R are individually true but R is not the correct explanation of A
c. A is true but R is false
d. A is false but R is true

113. Assertion (A) : Superposition theorem is used to particular branch in a linear network calculate the current in a of each of the independent sources, by considering the effect taken one-at a time.

Reason (R) : In a linear network, the behaviour of the circuit does not vary depending upon the source.

a. Both A and R are individually true and R is the correct explanation of A
b. Both A and R are individually true but R is not the correct explanation of A
c. A is true but R is false
d. A is false but R is true

114. Assertion (A) : Maximum power transfer from a source with complex internal impedance to a complex load will occur if the source impedance is same as the load impedance.

Reason (R) : The efficiency of maximum power transfer cannot exceed 50%.

a. Both A and R are individually true and R is the correct explanation of A
b. Both A and R are individually true but R is not the correct explanation of A
c. A is true but R is false
d. A is false but R is true

115. Assertion (A) : The current in a series R-L-C circuit driven by a sinusoidal voltage source may lead, lag or be in phase with the applied voltage.

Reason (R) : Series resonance does not imply unity power factor condition.

a. Both A and R are individually true and R is the correct explanation of A
b. Both A and R are individually true but R is not the correct explanation of A
c. A is true but R is false
d. A is false but R is true

116. Assertion (A) : A two-terminal network representing a given driving point reactance function is said to be a canonic or a fundamental network.

Reason (R) : A driving point reactance function is totally specified by the location of poles and zeros.

a. Both A and R are individually true and R is the correct explanation of A
b. Both A and R are individually true but R is not the correct explanation of A
c. A is true but R is false
d. A is false but R is true

117. Assertion (A) : For extremely high frequency ranges or above, compared to linear antennas, aperture antennas are more useful.

Reason (R) : The larger the effective area of an antenna, the sharper is the radiated beam.

a. Both A and R are individually true and R is the correct explanation of A
b. Both A and R are individually true but R is not the correct explanation of A
c. A is true but R is false
d. A is false but R is true

118. Assertion (A) : The quality factor Q of a waveguide is closely related to its attenuation factor $\alpha$.

Reason (R) : Normally attenuation factors obtainable in waveguides are much higher than those obtainable in transmission lines.

a. Both A and R are individually true and R is the correct explanation of A
b. Both A and R are individually true but R is not the correct explanation of A
c. A is true but R is false
d. A is false but R is true

119. Assertion (A) : A VTVM is preferred to an ordinary multimeter for measurement of voltages in an electronic circuit.

Reason (R) : A VTVM has built-in amplifier and it gives very accurate results.

a. Both A and R are individually true and R is the correct explanation of A
b. Both A and R are individually true but R is not the correct explanation of A
c. A is true but R is false
d. A is false but R is true

120. Assertion (A) : Operational amplifiers are commonly used in instrumentation.

Reason (R) : The operational amplifiers do not load the circuit due to their very high input impedance.

a. Both A and R are individually true and R is the correct explanation of A
b. Both A and R are individually true but R is not the correct explanation of A
c. A is true but R is false
d. A is false but R is true