

ELECTRONICS & TELECOMMUNICATION ENGINEERING

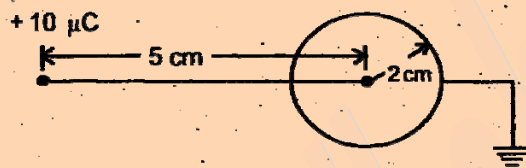
PAPER-I

1. Which one of the following statements is correct?

A right circularly polarized wave is incident from air onto a polystyrene ($\epsilon_r = 2.7$). The reflected wave is

- right circularly polarized
- left circularly polarized
- right elliptically polarized
- left elliptically polarized

2. A point charge of $+10 \mu\text{C}$ placed at a distance of 5 cm from the centre of a conducting grounded sphere of radius 2 cm is shown in the diagram given below:



What is the total induced charge on the conducting sphere?

- $10 \mu\text{C}$
 - $4 \mu\text{C}$
 - $5 \mu\text{C}$
 - $12.5 \mu\text{C}$
3. For sea water $\sigma = 5 \text{ mho/m}$ and $\epsilon_r = 80$, what is the distance for which radio signal can be transmitted with 90% attenuation at 25 kHz?
- 0.322 m
 - 3.22 m
 - 32.2 m
 - 322 m
4. Two metal rings 1 and 2 are placed in a uniform magnetic field which is decreasing with time with their planes perpendicular to the field. If the rings are identical except that ring 2 has a thin air gap in it, which one of the following statements is correct?
- No e.m.f is induced in ring 1
 - An e.m.f is induced in both the rings
 - Equal joule heating occurs in both the rings

- d. Joule heating does not occur in either ring

5. The electric field of a wave propagating through a lossless medium ($\mu_0, 81\epsilon_0$) is

$$\vec{E} = 10 \cos(6\pi \times 10^8 t - \beta x) \vec{a}_y$$

What is the phase constant β of the wave?

- $2\pi \text{ rad/m}$
- $9\pi \text{ rad/m}$
- $18\pi \text{ rad/m}$
- $81\pi \text{ rad/m}$

6. Which one of the following gives the values of the attenuation factor α and phase shift factor β for a wave propagated in a good dielectric having $\sigma/(\omega\epsilon) \gg 1$?

- $\alpha = \frac{[\sigma\sqrt{\mu/\epsilon}]}{2}; \beta = \omega\sqrt{\mu\epsilon}$
- $\alpha = \sqrt{\mu/\epsilon}; \beta = \sqrt{\omega\mu/\epsilon}$
- $\alpha = \frac{[\sigma\sqrt{\mu/\epsilon}]}{2}; \beta = \sqrt{\omega\mu\epsilon}$
- $\alpha = 0; \beta = \omega^2\mu\epsilon$

7. If the phase velocity of a plane wave in a perfect dielectric is 0.4 times its value in free space, then what is the relative permittivity of the dielectric?

- 6.25
- 4.25
- 1.25
- 2.5

8. In free space

$$\vec{E}(x, t) = 60 \cos(\omega t - 2x) \vec{a}_y \text{ V/m}$$

What is the average power crossing a circular area of radius 4 m in the plane $x = \text{constant}$?

- 480 W
- 240 W
- 120 W
- 60 W

9. Consider the following statements regarding Smith charts:

1. A normalized smith chart applies to a line of any characteristic resistance and serves as well for normalized admittance
2. A polar coordinate Smith chart constrains circles of constant $|z|$ and circles of constant $\angle z$
3. In Smith chart, the distance towards the load is always measured in clockwise direction

Which of the statements given above are correct?

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

10. A $(100 - j 75)\Omega$ load is connected to a co-axial cable of characteristic impedance 75 ohms at 12 GHs. In order to obtain the best matching, which one of the following will have to be connected?

- a. A short-circuited stub at load
- b. Inductance at load
- c. A capacitance at a specific distance at load
- d. A short-circuited stub at some specific distance from load

11. What is the effect of the earth's magnetic field in the reflected wave at frequencies in the vicinity of gyro-frequency?

- a. No attenuation in the reflected wave
- b. Decreased attenuation in the reflected wave
- c. Increased attenuation in the reflected wave
- d. Nominal attenuation in the reflected wave

12. Consider the following statements. Relating to the cavity resonators

1. For over-coupling the cavity terminals are at voltage maximum in the input line at resonance
2. For over-coupling the cavity terminals are at the voltage minimum in the input line at resonance
3. For under-coupling the normalized impedance at the voltage maximum is the standing wave ratio

4. For over-coupling the input terminal impedance is equal to the reciprocal of the standing wave ratio

Which of the statements given above are correct?

- a. 1 and 2
- b. 3 and 4
- c. 1 and 3
- d. 2 and 4

13. Which one of the following statements is correct? Short-circuited stubs are preferred to open-circuited stubs because the latter are

- a. more difficult to make and connect
- b. made of a transmission line with a different characteristic impedance
- c. liable to radiate energy
- d. incapable of giving a full range of frequencies.

14. Which one of the following statements is correct?

An antenna array consists of 5 omnidirectional elements carrying equal in-phase currents. The elements are equally spaced along x-axis with the spacing between adjacent elements being equal to one wavelength. The directivity pattern will have a maximum

- a. only in x-direction
- b. only in y-direction
- c. both x- and y-direction
- d. in the direction making an angle of 45° with x-axis

15. Match List I (Properties of Standard Resistance Materials) with List II (Resistance Quality) and select the correct answer using the codes given below

List I

- A. High resistivity
- B. Small temperature coefficient
- C. Permanence with time
- D. Low thermo-electric e.m.f. with copper

List II

1. Low measuring error
2. Small change of resistance due to ageing
3. Resists oxidation and corrosion
4. Low resistance change with temperature

5. Small size of resistor

Codes;

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

16. A voltmeter has a range 0 - 20 V and manufacturer rates its accuracy as $\pm 1\%$ fsd. Match List I (Voltage Values) with List II (Error as Percentage of True Value) and select the correct answer using the codes given below

List I

- A. 2V
- B. 5V
- C. 10 V
- D. 20 V

List II

- 1. 4%
- 2. 10%
- 3. 2%
- 4. 1%

Codes;

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

17. Which one of the following defines resolution?

- a. The least interval between two adjacent discrete details, which can be distinguished from one another
- b. The largest interval between highest and lowest measured values, that the device can be adjusted to measure
- c. The least interval between highest and lowest measured values, that the device can be adjusted to measure
- d. The ratio of a change in output magnitude to the change in the input which causes it, after the steady state has been reached

18. Match List I (Characteristic to be Obtained) with List II (Arrangement of Radiators) and select the correct answer using the codes given below

List

- A. Concentration of radiation in azimuth
- B. Concentration of radiation in elevation
- C. Bi-directional pattern

List II

- 1. Two radiators spaced $3\lambda/4$ apart and fed with currents having 180° phase difference
- 2. Two radiators spaced $\lambda/4$ apart and fed with currents having 90° phase difference
- 3. Radiators arranged to form broadside array with horizontal array line
- 4. Radiators arranged to form broadside array with vertical array line

Codes;

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

19. In magnetic measurements, Lloyd-Fisher square is used in the determination of which one of the following?

- a. B-H curve
- b. B-H loop
- c. Both B-H curve and B-H loop
- d. Iron losses

20. Which one of the following statements is not correct in connection with electro dynamic instruments?

- a. As the coils are air-cored, these instruments are free from Hysteresis and eddy current losses
- b. These instruments have a high torque/weight ratio and hence have a high sensitivity
- c. These instruments can be used on both ac. and d.c., and are very useful where accurate r.m.s. values of voltage, irrespective of waveforms, are required
- d. These are more expensive than either PMMC or moving-iron type instruments

21. Consider the following statements:

The major problem in most of the ac. bridges is control of electric fields in order to minimize the capacitance effects between bridge components and from them to ground. The effects due to this electric field can be minimized by

1. separating various components of the bridge as widely as practicable
2. controlling capacitance so as to enclose bridge components in conducting shields, connected to place the capacitances where it does not harm
3. using Wagner's earthing device
4. using high grade insulation and mounting the apparatus on insulating stands

Which of the statements given above are correct?

- a. 1, 2 and 3
 - b. 2 and 3
 - c. 1 and 3
 - d. 1, 2 and 4
22. Damping torque in the disc of an a.c. energy meter is provided by which one of the following?
- a. Electrostatic effect
 - b. Magneto static effect
 - c. Eddy current effect
 - d. Chemical effect
23. The x-input and y-input to a CRO are, $5 \cos (\omega t + \phi)$ and $5 \sin (\omega t + \phi)$, respectively. What will be the resulting Lissajous pattern?
- a. A straight line inclined to an angle ϕ
 - b. An ellipse with an inclined major axis
 - c. A circle
 - d. A horizontal line
24. In a digital voltmeter, input signal is integrated for duration of 500 clock cycles. To eliminate the effect of 100 Hz noise present in the signal, what is the maximum clock frequency?
- a. 5 kHz
 - b. 50 kHz
 - c. 100 kHz
 - d. 250 kHz
25. The Schmitt Trigger is used in certain digital frequency meters. What is its purpose?
- a. To convert input signal into pulses of short duration
 - b. To provide time-base signal of saw tooth type
 - c. To convert input sinusoidal signal into rectangular Pulses

- d. To have scaling of sinusoidal waveforms

26. Which one of the following statements is not correct?

- a. The power requirements of digital instruments are considerably lower than that of analog instruments
- b. In analog instruments, the resolution limit is one part in several hundreds, whereas digital instruments can be made with a resolution of one part in several thousands
- c. Digital instruments are extremely portable and usually do not require an outside source of supply for measurements
- d. Digital instruments indicate the readings directly in decimal numbers and therefore errors due to parallax and approximation, etc., are eliminated

27. Which one of the following is the principal disadvantage of a piezoelectric transducer?

- a. It can measure force only
- b. It cannot measure static conditions
- c. It is too small to handle
- d. It produces only d.c. voltage

28. A square wave is defined by

$$x(t) = \begin{cases} A, & 0 < t < T_0 / 2 \\ -A, & T_0 / 2 < t < T_0 \end{cases}$$

It is periodically extended outside this interval. What is the general coefficient a_n in the Fourier expansion of this wave?

- a. 0
- b. $\frac{2A(1 - \cos n\pi)}{n\pi}$
- c. $\frac{2A(1 + \cos n\pi)}{n\pi}$
- d. $\frac{2A(1 - \cos n\pi)}{[(n+1)\pi]}$

29. What is the inverse Laplace transform of $\frac{e^{-as}}{s}$?

- a. e^{-at}
- b. $u(t-a)$
- c. $\delta(t-a)$
- d. $(t-a)u(t-a)$

30. Match List I (Time Domain Property) with List II (Frequency Domain Property) pertaining to Fourier Representation Periodicity Properties and select the correct answer using the codes given below

List I

- A. Continuous
- B. Discrete
- C. Periodic
- D. Non-periodic

List II

- 1. Periodic
- 2. Continuous
- 3. Non-periodic
- 4. Discrete

Codes;

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

31. Given that $x_1(t) = e^{k_1 t} u(t)$ and $x_2(t) = e^{-k_2 t} u(t)$. Which one of the following gives their convolution?

- a. $\frac{[e^{k_1 t} - e^{-k_2 t}]}{[k_1 + k_2]}$
- b. $\frac{[e^{k_1 t} - e^{-k_2 t}]}{[k_2 - k_1]}$
- c. $\frac{[e^{k_1 t} + e^{-k_2 t}]}{[k_1 + k_2]}$
- d. $\frac{[e^{k_1 t} + e^{-k_2 t}]}{[k_2 - k_1]}$

32. Which one of the following must be satisfied if a signal is to be periodic for $-\infty < t < \infty$?

- a. $x(t + T_0) = x(t)$
- b. $x(t + T_0) = dx(t) / dt$
- c. $x(t + T_0) = \int_t^{T_0} x(t) dt$
- d. $x(t + T_0) = x(t) + kT_0$

33. Which is the output of the system with $h[n] = (1/2)^n u(n)$ in response to the input $x[n] = 3 + \cos\left(\pi n + \frac{\pi}{3}\right)$

- a. $y[n] = 3 + \frac{1}{3} \left[\cos\left(\pi n + \frac{\pi}{3}\right) \right]$
- b. $y[n] = 3 + \frac{2}{3} \left[\cos\left(\pi n + \frac{\pi}{3}\right) \right]$
- c. $y[n] = 1 + \frac{2}{3} \left[\sin\left(\pi n + \frac{\pi}{3}\right) \right]$
- d. $y[n] = 6 + \frac{2}{3} \left[\cos\left(\pi n + \frac{\pi}{3}\right) \right]$

34. A discrete time system has impulse response $h(n) = a^n u(n+2)$, $|a| < 1$. Which one of the following statement is correct? The system is

- a. Stable, causal and memory less
- b. Unstable, causal and has memory
- c. stable, non-causal and has memory
- d. unstable, non-causal and memory less

35. What is the number of roots of the polynomial $F(Z) = 4z^3 - 8z^2 - z + 2$, laying outside the unit circle?

- a. 0
- b. 1
- c. 2
- d. 3

36. Which one of the following gives the cross-correlation ($Y_{xy}(k)$) of two finite length sequences $x(n) = \{1, 3, 1, 2\}$ and $y(n) \{1, 2, 1, 3\}$?

- a. $\{3, 10, 8, 14, 7, 5, 21\}$
- b. $\{2, 10, 7, 14, 6, 6, 3\}$
- c. $\{3, 9, 8, 14, 7, 5, 2\}$
- d. $\{2, 10, 6, 14, 7, 5, 3\}$

37. Which one of the following gives the average value or expectation of the function $g(X)$ of the random variable X ?

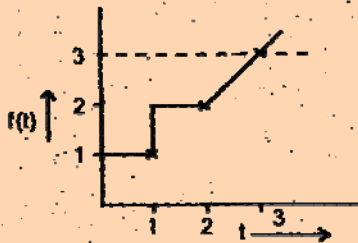
{Given $f(X)$ is the probability density function}

- a. $E[g(X)] = \int_{-\infty}^{\infty} g(X) dX$
- b. $E[g(X)] = \int_{-\infty}^{\infty} g(X) f(X) dX$

c. $E[g(X)] = \int_{-\infty}^{\infty} g^*(X) dX$

d. $E[g(X)] = \int_{-\infty}^{\infty} \left[\frac{g(X)}{f(X)} \right] dX$

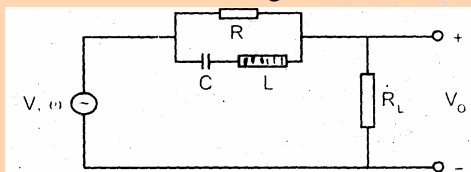
38. Consider the following waveform diagram:



Which one of the following gives the correct description of the waveform shown in the above diagram?

- $u(t) + u(t-1)$
- $u(t) + (t-1)u(t-1)$
- $u(t) + u(t-1) + (t-2)u(t-2)$
- $u(t) + (t-2)u(t-2)$

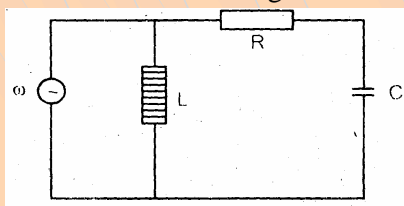
39. Consider the following circuit:



For the above circuit, which one of the following statements is correct? The voltage V_o is independent of R , if the input signal frequency ω is

- $1/\sqrt{LC}$
- $1/[2\sqrt{LC}]$
- \sqrt{LC}
- Has any value

40. Consider the following circuit:



For what value of ω , the circuit shown above exhibits unity power factor?

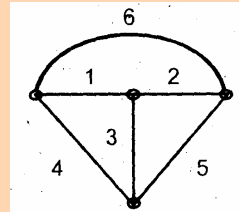
- $\frac{1}{\sqrt{LC}}$

b. $\frac{1}{\sqrt{LC - R^2 C^2}}$

c. $\frac{1}{\sqrt{LC + R^2 C^2}}$

d. $\frac{1}{RC}$

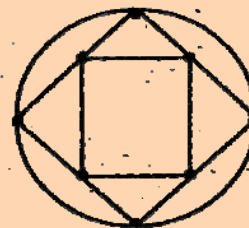
41. Consider the following graph:



Which one of the following is not a tree of the above graph?

-
-
-
-

42. Consider a spanning tree of the connected graph:



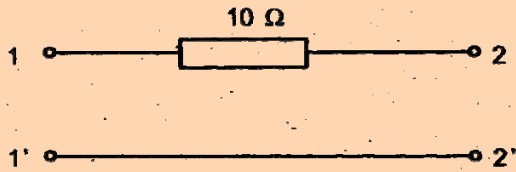
What is the number of fundamental cut-sets?

- 15
- 16
- 8

d. 7

43. The input voltage V_1 and current I_1 for a linear passive network is given by $V_1 = AV_2 + BI_2$ and $I_1 = CV_2 + DI_2$

Now consider the following network:



Which one of the following is the transfer matrix?

$$\begin{bmatrix} A & B \\ C & D \end{bmatrix}$$

of the network shown above?

- a. $\begin{bmatrix} 1 & 0 \\ 0 & 10 \end{bmatrix}$
- b. $\begin{bmatrix} 1 & 10 \\ 0 & 1 \end{bmatrix}$
- c. $\begin{bmatrix} 0 & 1 \\ 10 & 1 \end{bmatrix}$
- d. $\begin{bmatrix} 0 & 10 \\ 1 & 0 \end{bmatrix}$
44. For an ideal step-down ($n:1$) transformer, which one of the following is the ABCD parameter matrix?

- a. $\begin{bmatrix} n & 1 \\ 1 & n \end{bmatrix}$
- b. $\begin{bmatrix} n & 0 \\ 0 & n \end{bmatrix}$
- c. $\begin{bmatrix} n & 0 \\ 0 & 1/n \end{bmatrix}$
- d. $\begin{bmatrix} n & 1/n \\ 1/n & 1 \end{bmatrix}$

45. Which one of the following is the transfer function of an electrical low pass filter using R and C elements?

- a. $\frac{RCS}{[1 + RCS]}$
- b. $\frac{1}{[1 + RCS]}$

- c. $\frac{RC}{[1 + RCS]}$
- d. $\frac{S}{[1 + RCS]}$

46. The electrical resistivity of sodium silicate glass is $10^5 \Omega\text{m}$ whereas that of pure silica glass is $10^{17} \Omega\text{m}$. This vast difference of 12 orders of magnitude is due to which one of the following reasons?

- a. The loosely-bound sodium ions in the silicate
- b. The impurities in silica
- c. The difference in the crystal structures
- d. The presence of free electrons in the silicate

47. Match List I (Type of Material) with List II (Type of Bonding) and select the correct answer using the codes

List I

- A. Elemental semiconductor
- B. Hydrogen molecule
- C. Copper
- D. AgI

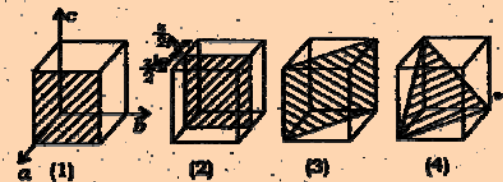
List II

1. Ionic
2. Covalent
3. van der Waals
4. Metallic

Codes;

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

48. Consider the following crystallographic planes (shaded) using a cube of size z as shown in the diagram



Which one of the following gives Miller indices of the above planes in order?

- a. (110), (200), (100), (111)
- b. (100), (200), (110), (111)
- c. (111), (110), (200), (100)

- d. (200), (11 1), (110), (100)
49. Match List I (Material) with List II (Band Gap) and select the correct answer using the codes given below

List I

- A. Metal
- B. Semimetal
- C. Semiconductor
- D. Insulator

List II

- 1. 9 eV
- 2. 0.05 eV
- 3. 1.5 eV
- 4. 0 or less

Codes;

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

50. A copper wire is 1 metre long and has a uniform cross-section of 0.1 mm^2 . The resistance of the wire at room temperature is 0.171 ohm. What is the resistivity of the material?
- a. $1.71 \times 10^{-6} \Omega.m$
 - b. $1.71 \times 10^{-7} \Omega.m$
 - c. $1.71 \times 10^{-8} \Omega.m$
 - d. $1.71 \times 10^{-9} \Omega.m$
51. What is the approximate mobility of holes in Germanium at room temperature?
- a. $4500 \text{ cm}^2/\text{V.s}$
 - b. $2400 \text{ cm}^2/\text{V.s}$
 - c. $1800 \text{ cm}^2/\text{V.s}$
 - d. $900 \text{ cm}^2/\text{V.s}$
52. The diffusion of both electrons and holes occurs in a semiconductor (with q = charge of electron/hole; D_n, D_p = diffusion constant for electrons/holes; $\partial n / \partial x, \partial p / \partial x$ = gradient for electrons/holes). What is the total diffusion current (J_{diff})?
- a. $qD_n \frac{\partial n}{\partial x} + qD_p \frac{\partial p}{\partial x}$
 - b. $qD_n \frac{\partial}{\partial x} \left(\frac{\partial n}{\partial x} \right) + qD_p \frac{\partial}{\partial x} \left(\frac{\partial p}{\partial x} \right)$

c. $qD_n \frac{\partial}{\partial x} \left(\frac{\partial n}{\partial x} \right) - qD_p \frac{\partial}{\partial x} \left(\frac{\partial p}{\partial x} \right)$

d. $qD_n \frac{\partial n}{\partial x} - qD_p \frac{\partial p}{\partial x}$

53. The material which has the property of becoming electrically polarized in response to an applied mechanical stress is termed as
- a. Ferroelectric
 - b. Piezoelectric
 - c. Optoelectronic
 - d. Superconducting

54. Consider the following statements relating to piezoelectric materials and their effects

- 1. Stress applied to the material produces electric polarization
- 2. An electric field applied to the material produces strain in it
- 3. All piezoelectric materials are also ferroelectric materials

Which of the statements given above are correct?

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

55. Consider the following statements In a ferroelectric material

- 1. all domains are lined up in the direction of applied field giving rise to saturation
- 2. if the field is reduced to zero, many domains remain aligned
- 3. the remnant polarization can be eliminated only if the material is heated above Curie temperature

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

56. Consider the following statements related to ferroelectric materials above the Curie temperature

- 1. It is in the paramagnetic state
- 2. Its electric susceptibility is inversely proportional to its temperature
- 3. Magnitude of electric susceptibility goes down by a factor of few hundreds

in comparison to the value below the Curie temperature

Which of the statements given above are correct?

- 1, 2 and 3
- 1 and 2
- 2 and 3
- 1 and 3

57. The electric displacement D in a material is expressed as $D = \epsilon E + d.s$ where ϵ is the permittivity, E is the field, s is strain and d is a characteristic constant of the material. Which is this material?

- Metal
- Anti-ferromagnetic material
- Semiconductor
- Piezoelectric material

58. Which of the following statements are true for a semiconductor that is used as a photoconductor?

- It should have no doping
- It should have large response time
- It should have an energy band gap value that matches with frequency of light that is used to excite the photoconductor

Select the correct answer using the codes given below

- 1, 2 and 3
- 1 and 2
- 2 and 3
- 1 and 3

59. The magnetic material in which permanent atomic magnetic dipoles have parallel orientation is termed as which one of the following?

- Diamagnetic
- Paramagnetic
- Ferromagnetic
- Ferrimagnetic

60. Which one of the following materials is a ceramic material?

- Mica
- Zinc sulphide
- Antimony
- Copper

61. Match List I (Type of Capacitor) with List II (Characteristic) and select the correct answer using the codes

List I

- Paper
- Mica dielectric
- Ceramic dielectric
- Electrolytic

List II

- Low volume for large capacitance
- Inexpensive
- Suitable for RF bypass
- Long-term stability

Codes;

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

62. The material for the core in a power transformer must have

- high resistivity and low permeability
- low value of saturation magnetization and high resistivity
- high permeability and low resistivity
- high permeability and high saturation magnetization

63. Consider the following statements

The intrinsic concentration of a semiconductor

- depends on doping
- increases exponentially with decrease of band gap of the semiconductor
- increases non-linearly with increase of temperature
- increases linearly with increase of temperature
- Which of the statements given above are correct?

- 1, 2 and 3
- 1 and 3
- 2 and 3
- 2 and 4

64. Consider the following statements:

During an electron transition across the energy gap in an indirect energy gap material like silicon

- the momentum of the electron changes
- the direction of motion of the electron changes

3. the potential energy of the electron changes
4. the kinetic energy of the electron changes

Which of the statements given above are correct?

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

65. Which one of the following statements is correct?

Under small signal operation of a diode,

- a. its bulk resistance increases
- b. its junction resistance predominates
- c. it acts like a closed switch
- d. it behaves as a clipper

66. The voltage gain of a given common source JFET amplifier depends on its

- a. input impedance
- b. amplification factor
- c. dynamic drain resistance
- d. drain load resistance

67. Match List I (Equation) with List II (Relation between/Description) and select the correct answer using the

List I

- A. Continuity equation
- B. Einstein's equation
- C. Poisson's equation

List II

1. Relates diffusion constant with mobility
2. Relates charge density with electric field
3. Relates flow with rate of change of concentration in space
4. Rate of change of minority carrier density with time

Codes;

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

68. Match List I (Diode) with List II (Application) and select the correct answer using the codes given below:

List I

- A. Varactor diode
- B. Tunnel diode
- C. Photodiode
- D. Zener diode

List II

1. To- charge auxiliary storage batteries
2. Reference voltage
3. High frequency tuning circuits
4. High frequency switching circuit

Codes;

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

69. Which one of the following statements is not correct?

- a. The operation of LVDT can be adversely affected by stray magnetic a.c. fields or by the presence of large masses of metal nearby
- b. Fitting a magnetic shield with a longitudinal slot along it, over the transducer can largely be beneficial
- c. Relatively small displacements are required for appreciable differential output
- d. LVDT gives high output and many times, there is no need for amplification. It possesses a high sensitivity, which is typically of about 40 V/mm

70. Which one of the following defines piezo-resistive

- a. Production of voltage in a crystal subjected to mechanical strain
- b. Changes in the value of resistivity of a conductor which is strained
- c. Creation of strain in a crystal when electricity is passed through the crystal
- d. Increase in the frictional resistance of a sliding contact under the influence of magnetic field

71. Consider the following statements relating to an

LVDT type of transducer

1. A soft iron core provides the magnetic coupling between a: primary coil and

two secondary coils, connected in series opposition

2. The output is proportional to the displacement of the iron core
3. The device is very sensitive and is linear over a wide range of motion
4. This is a variable inductance transducer

Which of the statements given above are correct?

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

72. In microwave telemetry, repeater stations are required to cover large area. What is, generally, the distance between repeater stations?

- a. 10 km
- b. 20 km
- c. 40 km
- d. 100 km

73. Consider the following statements relating to the micro strip lines

1. Modes on microstrip lines are purely TEM
2. Microstrip line is also called open strip line
3. Radiation loss in microstrip line can be reduced by using thin high dielectric materials
4. Conformal transformation technique is quite suitable for solving microstrip problems

Which of the statements given above are correct?

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

74. Which one of the following, statements is correct?

Ionic crystals are

- a. hard and brittle
- b. soft and elastic
- c. hard and corrosive
- d. soft and, inflammable

75. Why does the electric conductivity of a solid solution alloy drop off rapidly with increased alloy content?

- a. Because the solid solution has a dielectric nature
- b. Because the solid solution has a less regular structure than that of a pure metal
- c. Because the solid solution has a higher conductivity than that of the alloying material
- d. Because the solid solution has a lower molecular weight

76. Ceramic insulators undergo a glazing process to reduce the possibility of electric breakdown. What is the effect of this process?

- a. It makes the surface non-absorbent
- b. It makes the surface reflecting
- c. It makes the surface curvature free
- d. It makes the surface moist

77. Which one of the folioing statements is correct?

A tunnel diode is always biased

- a. by a d.c. source
- b. in the middle of its negative resistance region
- c. in the positive resistance region nearest to zero
- d. in the reverse direction

78. How can the channel width in a junction field effect transistor be controlled?

- a. By two back-biased p-n junctions
- b. By the length of the source
- c. By the length of the drain
- d. By the lengths of both the source and the drain

79. What is the Nyquist rate for the signal

$$x(t) = \cos 2000\pi t + 3 \sin 6000\pi t$$

- a. 2 kHz
- b. 4 kHz
- c. 12 kHz
- d. 6 kHz

80. If the response of a system to an input does not the depend the future values of the input, then which one of following is true for the system?

- a. It is aperiodic
- b. it is causal

- c. It is anticipatory
d. It is discrete
81. Which one of the following statements is correct?
A second-order system is critically damped when the roots of its characteristic equation are
a. negative, real and unequal
b. complex conjugates
c. negative, real and equal
d. positive, real and equal
82. Assertion (A): At room temperature, in the absence of an external field, a barium titanate ferroelectric crystal exhibits no polarisation.
Reason (R): There are no dipoles in this crystal at room temperature in the, absence of an external field.
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
83. Assertion (A): Resistivity of ferrites is very, much lower than that of ferromagnetic materials.
Reason (R): Ferrites are chemical compounds and the electrons in them are subject to the restraint of valence forces.
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
84. Assertion (A): The concentration measured by Hall effect does not have much significance if the semiconductor is non-homogeneously doped.
Reason (R): The current density is uniform throughout the thickness of the semiconductor.
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
85. Assertion (a): A periodic function satisfying Dirichlet's conditions can be expanded into a Fourier series.
Reason (R): A Fourier series is. a summation of weighted sine and cosine waves of the fundamental frequency and its harmonics.
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
86. Assertion (A): A driving point impedance function has multiple zeros on $j\omega$ -axis of the s-plane
Reason (R): A positive real function has no multiple poles or zero on $j\omega$ -axis of the s-plane.
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
87. Assertion (A): A ballistic galvanometer does not produce a steady-state deflection and its pointer oscillates with decreasing amplitude.
Reason (R): The ballistic galvanometer is made to have critical damping.
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
88. Assertion (A): The variation of parameters with temperature is more in FET than in BJT
Reason (R): The change in mobility of carriers due to temperature is compensated by increase in concentration of carriers due to temperature in field effect transistors.
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

89. Assertion (A): An electronic voltmeter reads voltage drop across a very high resistance used in an electronic circuit more accurately than a voltmeter which uses the same PMMC instrument as the indicating device used in the electronic voltmeter.
Reason (R): The accuracy of the electronic voltmeter is less than that of the PMMC instrument used in it.
- Both A and R are individually true and R is the correct explanation of A
 - Both A and R are individually true but R is not the correct explanation of A
 - A is true but R is false
 - A is false but R is true
90. A bipolar junction transistor is in saturation region. Given $V_{cc} = 10V$, $R_c = 1k\Omega$, $h_{FE} = 100$ and $V_{CE sat} = 0.3V$. What is the collector current in saturation?
- 10 mA
 - 9.7 mA
 - 0 mA
 - 1 mA
91. Consider the following statements
An SCR, from its OFF state, can be made ON by
- increasing its anode voltage
 - increasing its gate current
 - decreasing its gate voltage
 - decreasing its anode current
- Which of the statements given above are correct?
- Either 1 or 2
 - Either 1 or 3
 - Either 2 or 4
 - Either 3 or 4
92. Which one of the following statements is correct?
In the context of IC fabrication, metallization means
- connecting metallic wires
 - formation of interconnecting conduction pattern and bonding pads
 - doping SiO₂ layer
 - covering with a metallic cap
93. Consider the following
- Cheaper method
 - Low residual oxygen content in the grown crystal is possible
 - Uniform doping is possible
 - Larger diameter crystals can be grown
 - Which of the above are the advantages of the float zone (FZ) method over the Czochralski (CZ) method in single crystal growth of silicon?
- 1 and 2
 - 2 and 3
 - 3 and 4
 - 1 and 4
94. Which one of the following statements is correct?
The set of transistor characteristics that enables β to be directly determined from the slope is
- the common-emitter output characteristics
 - the common-emitter transfer characteristics
 - the common-base input characteristics
 - the common-base transfer characteristics
95. Which one of the following statements is correct?
For an MOS capacitor fabricated on a p-type semiconductor strong inversion occurs when surface potential is
- equal to Fermi potential
 - zero
 - negative and equal to Fermi potential in magnitude
 - positive and equal to Fermi potential in magnitude
96. In which one of the following, two optical polarisers, one in front and other in back are needed?
- LED
 - LCD
 - LDR
 - LSI
97. $y[n] = \sum_{k=-\infty}^n x[k]$
Which one of the following systems is inverse of the system given above?
- $x[n] = y[n] - y[n-1]$

b. $x[n] = y[n]$

c. $x[n] = y[n+4]$

d. $x[n] = ny[n]$

98. What is the phase angle of the composite sinusoidal signal resulting from the addition of $v_1(n) = \sin[5\pi n]$ and $v_2(n) = \sqrt{2} \cos[5\pi n]$

a. $+5\pi$

b. -5π

c. $+\pi$

d. $-\pi/3$

99. Match List I (Equation Connecting Input $x(n)$ and Output $y(n)$) with List II (System Category) and select the correct answer using the codes given below:

List I

A. $y(n+2) + y(n+1) + y(n) = 2x(n+1) + x(n)$

B. $n^2 y^2(n) + y(n) = x^2(n)$

C. $y(n+1) + ny(n) = 4nx(n)$

D. $y(n+1)y(n) = 4x(n)$

List II

1. Linear, time-variable, dynamic
2. Linear, time-invariant, dynamic
3. Non-linear, time-variable, dynamic
4. Non-linear, time-invariant, dynamic
5. Non-linear, time-variable, memory less

Codes;

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

100. To which one of the following difference equations, the impulse response $h(n) = \delta(n+2) - \delta(n-2)$ corresponds?

a. $y(n+2) = x(n) - x(n-2)$

b. $y(n-2) = x(n) - x(n-4)$

c. $y(n) = x(n+2) + x(n-2)$

d. $y(n) = -x(n+2) + x(n-2)$

101. Laplace transforms of $f(t)$ and $g(t)$ are $F(s)$ and $G(s)$, respectively. Which one of the

following expressions gives the inverse Laplace transform of $F(s)G(s)$?

a. $f(t)g(t)$

b. $f(t)/g(t)$

c. $f(t) + g(t)$

d. $f(t) * g(t)$

102. The impulse response of a linear, time-invariant system is a rectangular pulse of duration 1. It is excited by an input of a pulse of duration T . What is the filter output waveform?

a. Rectangular pulse of duration T

b. Rectangular pulse of duration $2T$

c. Triangular pulse of duration T

d. Triangular pulse of duration $2T$

103. Consider the following systems:

1. $y[k] = x[k] + a_1 x[k-1] - b_1 y[k-1] - b_2 y[k-2]$

2. $y[k] = x[k] + a_1 x[k-1] + a_2 x[k-2]$

3. $y[k] = x[k+1] + a_1 x[k] + a_2 x[k-1]$

4. $y[k] = a_1 x[k] + a_2 x[k+1] - b_1 y[k-2]$

Which of the systems given above represent recursive discrete systems?

a. 1 and 4

b. 1 and 2

c. 1, 2 and 3

d. 2, 3 and 4

104. A linear constant parameter continuous-time system has the following A matrix in its state representation $\dot{X} = AX + Bu$

$$A = \begin{bmatrix} 0 & \alpha \\ \alpha & 0 \end{bmatrix}$$

Which one of the following is the natural response of the system following the application of any input?

a. $Me^{\alpha t} + Ne^{-\alpha t}$

b. $(M + Nt)e^{\alpha t}$

c. $(M + Nt)e^{-\alpha t}$

d. $M \cos \alpha t + N \sin \alpha t$

105. For half-wave (odd) symmetry, with T_0 = period of $x(t)$, which one of the following is correct?

a. $x(t \pm T_0/2) = -x(t)$

b. $x(t \pm T_0/2) = x(t)$

c. $x(t \pm T_0) = -x(t)$

d. $x(t \pm T_0) = x(t)$

106. If $X(s) = \frac{1}{(1+s)}$ is the given network

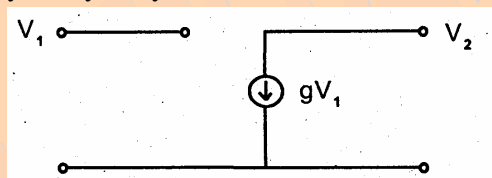
function, which one of the following describes the correct Bode plot?

- A straight line with a slope of -20 dB/decade passing through the point 0 dB and 1 rad/s
- A straight line with a slope of 20 dB/decade passing through the point 0 dB and 1 rad/s
- Constant at 0 dB for $\omega < 1$ and a slope of +20 dB/decade for $\omega > 1$
- Constant at 0 dB for $\omega < 1$ and a slope of -20 dB/decade for $\omega > 1$

107. The driving point impedance of a reactive network has poles at $\omega = 0, 40$ rad/s and infinity. Zeros are located at $\omega = 20$ and 60 rad/s. The impedance at 10 rad/s is $-j70 \Omega$. Which one of the following gives the form of the first Foster network of the driving point impedance function?

- An inductor L_1 a parallel combination, of an inductor L_2 and a capacitor C_2 ; and a capacitor C_3 , all in series
- Two, parallel combinations of inductors and capacitors in series
- Two series combination of inductors and capacitors connected in parallel
- None of the above

108. The 2-port network shown in the circuit given below is connected in parallel with another 2-port network which has $y_{11} = -y_{12} = -y_{21} = y_{22} = Y$



The y -parameters of the composite network will satisfy which one of the following?

- $y_{11} = Y + g$
- $y_{12} = -Y + g$
- $y_{21} = -Y + g$
- $y_{22} = Y + g$

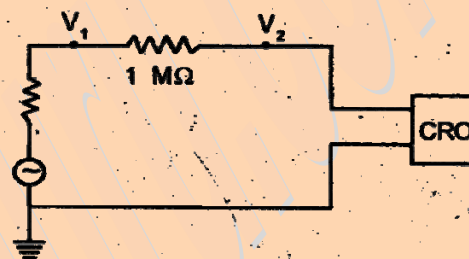
109. Which one of the following statements is correct? The poles and zeros of the driving point reactance function of an L-C network

- lie on the real axis of the s -plane
- alternate
- lie on the unit circle
- are arbitrary

110. What is the locus of the tip of the voltage phasor across R in a series R-L-C circuit?

- A parabola
- An ellipse
- A circle
- A rectangular hyperbola

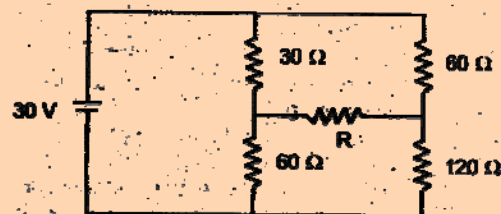
111. Consider the following circuit



If $V_1 = 5V$ and $V_2 = 3V$, then what is the input impedance of the CRO in the above circuit?

- 1 MΩ
- 1.5 MΩ
- 3 MΩ
- 5 MΩ

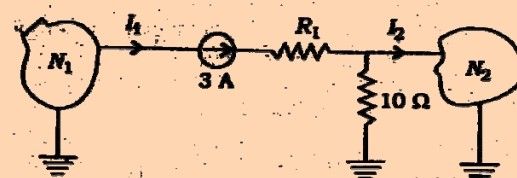
112. Consider the following circuit



What is the power delivered to resistor R in the above circuit?

- 15 W
- 0 W
- 15 W
- Cannot be determined unless the value of R is known

113. Consider the following circuit:

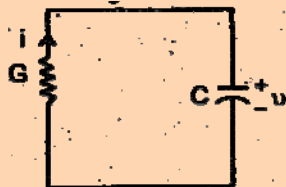


In the above circuit, the current I_2 is 2 A when the value of R_1 is 20Ω . What will be

the value of I_2 , when R_1 is changed to 10Ω ?

- a. 1 A
- b. 2 A
- c. 3 A
- d. 4 A

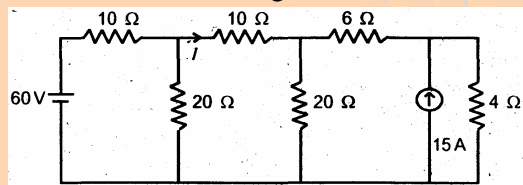
114. Consider the following network:



Which one of the following is the differential equation for v in the above network?

- a. $C \frac{dv}{dt} + Gv = 0$
- b. $G \frac{dv}{dt} + Cv = 0$
- c. $\frac{1}{C} \frac{dv}{dt} + Gv = 0$
- d. $C \frac{dv}{dt} - Gv = 0$

115. Consider the following circuit:



What is the current I in the above circuit?

- a. 0 A
- b. 2 A
- c. 5 A
- d. 6 A

116. Which one of the following statements is correct?

In a for-branch parallel circuit, 50 mA current flows in each branch. If one of the branches opens, the currents in the other branches

- a. increase
- b. decrease
- c. are unaffected
- d. double

117. An infinitely long uniform charge of density 30 nC/m is located at $y = 3, z = 5$. The field intensity at $(0, 6, 1)$ is $E = 64.7a_y - 86.3a_z \text{ V/m}$. What is the field intensity at $(5, 6, 1)$?

- a. E
- b. $\left(\frac{6^2 + 1^2}{5^2 + 6^2 + 1^2} \right) E$
- c. $\left(\frac{6^2 + 1^2}{5^2 + 6^2 + 1^2} \right)^{\frac{1}{2}} E$
- d. $\left(\frac{5^2 + 6^2 + 1^2}{6^2 + 1^2} \right)^{\frac{1}{2}} E$

118. What is the magnetic dipole moment in A.m^2 for a square current loop having the vertices at the points $A(10, 0, 0)$, $(0, 10, 0)$, $C(-10, 0, 0)$ and $D(0, -10, 0)$ and with current 0.01 A flowing in the sense ABCDA?

- a. $2\bar{a}_z$
- b. $-2\bar{a}_z$
- c. $4\bar{a}_z$
- d. $4(\bar{a}_x + \bar{a}_y)$

119. For an electric field $E = E_0 \sin \omega t$, what is the phase difference between the conduction current and displacement current?

- a. 0°
- b. 45°
- c. 90°
- d. 180°

120. An infinitely long line charge of uniform charge density $\rho_0 \text{ C/m}$ is situated parallel to and at a distance from the grounded infinite plane conductor. This field problem can be solved by which one of the following?

- a. By conformal transformation
- b. By method of images
- c. By Laplace's equation
- d. By Poisson's equation