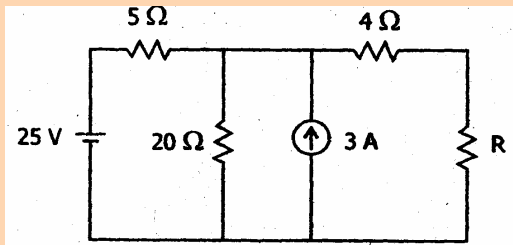


ELECTRONICS & TELECOMMUNICATION ENGINEERING

PAPER-I

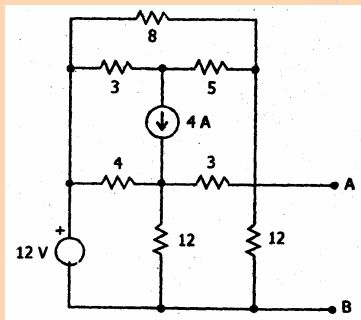
1.



What is the value of R required for maximum power transfer in the network shown above?

- a. $2\ \Omega$
- b. $4\ \Omega$
- c. $8\ \Omega$
- d. $16\ \Omega$

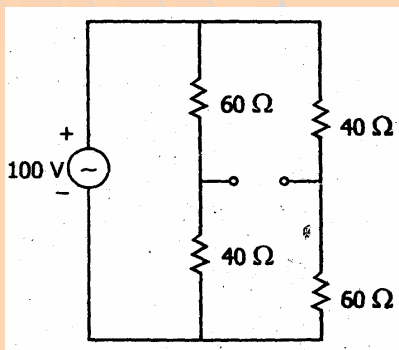
2.



What is the Thevenin resistance seen from the terminals AB of the circuit shown above in the figure?

- a. $2\ \Omega$
- b. $4\ \Omega$
- c. $8\ \Omega$
- d. $12\ \Omega$

3.



What are the source voltage and source resistance, respectively for the Thevenin's equivalent circuit as seen from the terminals indicated in the circuit given above?

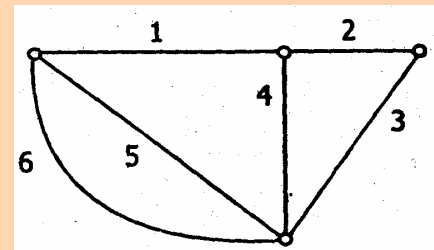
- a. 20 V, $24\ \Omega$
- b. 20 V, $48\ \Omega$
- c. 20 V, $4.8\ \Omega$
- d. 20 V, $12\ \Omega$

4.

A 2-terminal network consists of one of the RLC elements. The element is connected to an ac supply. The current through the element is I A. When an inductor is inserted in series between the source and the element, the current through the element becomes $2I$ A. What is this element?

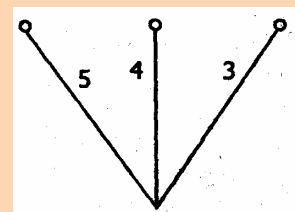
- a. A resistor
- b. An inductor
- c. A capacitor
- d. Cannot be a single element

5.

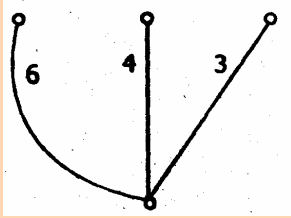


The graph of a network is shown in figure above, which one of the figures shown below is not a tree of graph?

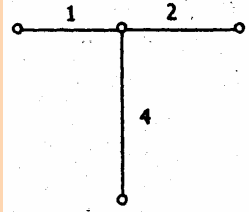
a.



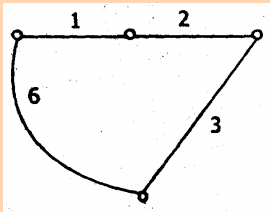
b.



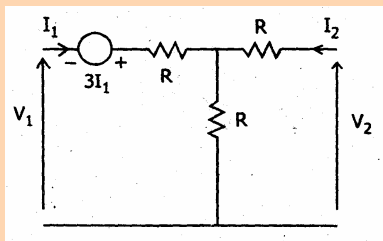
c.



d.



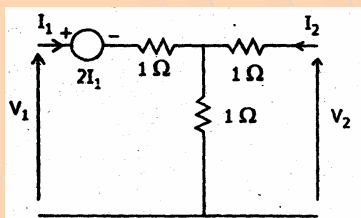
6.



Which one of the following is correct. The circuit shown in the figure above

- is reciprocal but not symmetrical
- is not reciprocal but symmetrical
- is both reciprocal and symmetrical
- is neither reciprocal nor symmetrical

7.



Which of the following is/are correct? The circuit shown in the above figure

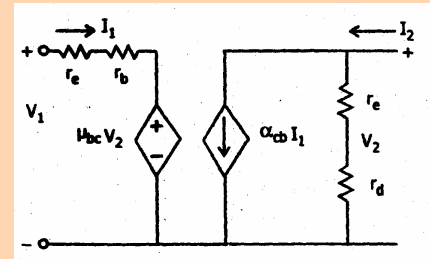
- is reciprocal
- has $Z_{11} = 2$, $Z_{22} = 2$
- has $Z_{11} = 4$, $Z_{22} = 2$
- has $Z_{11} = 0$, $Z_{22} = 2$

Select the correct answer using the code given below :

- 1 and 3
- 1 and 2

- 1 and 4
- 3 only

8.



Consider the two port transistor circuit as given above :

Match List-I with List-II and select the correct answer using the code given below the Lists :

List - I (Hybrid Parameter)

- h_{11}
- h_{12}
- h_{21}
- h_{22}

List - II (Circuit Element)

- $\frac{1}{r_e + r_d}$
- $r_b + r_e$
- μ_{bc}
- α_{cb}

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

9.

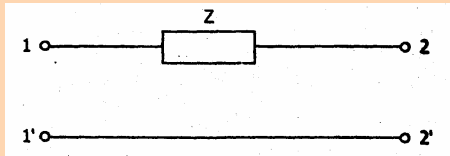
Consider the following statements associated with two-port networks :

- $Z_{12} = Z_{21}$
- $Y_{12} = Y_{21}$
- $h_{12} = h_{21}$
- $AD - BC = 1$

Which of the statements given above are correct ?

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

10.



What are the ABCD parameters of the single element circuit given above ?

- $\begin{bmatrix} 1 & Z \\ 0 & 1 \end{bmatrix}$
- $\begin{bmatrix} 1 & 1 \\ Z & 0 \end{bmatrix}$
- $\begin{bmatrix} 1 & Z \\ 1 & 0 \end{bmatrix}$
- $\begin{bmatrix} Z & 1 \\ 1 & 1 \end{bmatrix}$

11. Consider the following expression for the driving point impedance :

$$Z(s) = \frac{2(s^2 + 1)(s^2 + 9)}{s(s^2 + 4)}$$

- It represents an LC circuit
- It represents an RLC circuit
- It has poles lying on the $j\omega$ axis
- It has a pole at infinite frequency and a zero at zero frequency

Which of the statements given above are correct?

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

12. Consider the following statements for a driving point function $F(j\omega)$:

- $\text{Re } F(j\omega)$ is an even function of ω and is 0 or positive for all values of ω .
- $\text{Im } F(j\omega)$ is an even function of ω and is 0 or positive for all values of ω .
- $\text{Re } F(j\omega)$ is an odd function of ω and is 0 or negative for all values of ω .
- $\text{Re } F(s) = 0$ for $\text{Re } s = 0$.

Which of the statements given above is/are correct ?

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

13. A two port network is reciprocal if and only if:

- $Z_{11} = Z_{22}$
- $BC - AD = -1$
- $Y_{12} = -Y_{21}$
- $h_{12} = h_{21}$

14. $P(s) = s^4 + s^3 + 2s^2 + 4s + 3$
 $Q(s) = s^5 + 3s^3 + s$

Which one of the following statements is correct for above $P(s)$ and $Q(s)$ polynomials?

- Both $P(s)$ and $Q(s)$ are Hurwitz
- Both $P(s)$ and $Q(s)$ are non-Hurwitz
- $P(s)$ is Hurwitz but $Q(s)$ is non-Hurwitz
- $P(s)$ is non-Hurwitz but $Q(s)$ is Hurwitz

15. Which one of the following functions is an RC driving point impedance?

- $\frac{s(s+3)(s+4)}{(s+1)(s+2)}$
- $\frac{(s+3)(s+4)}{(s+1)(s+2)}$
- $\frac{(s+3)(s+4)}{s(s+1)(s+2)}$
- $\frac{(s+2)(s+4)}{(s+1)(s+3)}$

16. A reactive network has poles at $\omega = 0$, 4000 rad/s, and infinity and zeros at $\omega = 2000$ and 6000 rad/s. The impedance of the network is $-j 700$ Ohm at 1000 rad/s. What is the correct expression for the driving point impedance?

- $-j(0.1\omega) \frac{(\omega^2 - 4 \times 10^6)(\omega^2 - 36 \times 10^6)}{\omega^2(\omega^2 - 16 \times 10^6)} \text{ Ohm}$
- $j(0.1\omega) \frac{\omega^2(\omega^2 - 16 \times 10^6)}{(\omega^2 - 4 \times 10^6)(\omega^2 - 36 \times 10^6)} \text{ Ohm}$
- $j(0.1\omega) \frac{(\omega^2 - 4 \times 10^6)(\omega^2 - 36 \times 10^6)}{\omega^2(\omega^2 - 16 \times 10^6)} \text{ Ohm}$
- $-j(0.1\omega) \frac{\omega^2(\omega^2 - 16 \times 10^6)}{(\omega^2 - 4 \times 10^6)(\omega^2 - 36 \times 10^6)} \text{ Ohm}$

17. What is the minimum number of elements required to realize a given driving point susceptance function?

- a. One greater than the total number of internal poles and zeros
 b. Equal to the total number of internal poles and zeros
 c. One less than the total number of internal poles and zeros
 d. None of the above
18. Consider two signals $x_1(t) = e^{j20t}$ and $x_2(t) = e^{(-2+j)t}$.

Which one of the following statements is correct?

- a. Both $x_1(t)$ and $x_2(t)$ are periodic
 b. $x_1(t)$ is periodic but $x_2(t)$ is not periodic
 c. $x_2(t)$ is periodic but $x_1(t)$ is not periodic
 d. Neither $x_1(t)$ nor $x_2(t)$ is periodic

19. Which one of the following systems described by the following input-output relations is non-linear?

- a. $y(n) = n x(2n)$
 b. $y(n) = x(n^2)$
 c. $y(n) = n^2 x(n)$
 d. $y(n) = x^2(n)$

20. Which one of the following is the mathematical representation for the average power of the signal $x(t)$?

- a. $\frac{1}{T} \int_0^T x(t) dt$
 b. $\frac{1}{T} \int_0^T x^2(t) dt$
 c. $\frac{1}{T} \int_{-T/2}^{T/2} x(t) dt$
 d. $\lim_{T \rightarrow \infty} \frac{1}{T} \int_{-T/2}^{T/2} x^2(t) dt$

21. The discrete time signal $x(n)$ is defined by:

$$x(n) = \begin{cases} 1 & n = 1 \\ -1 & n = -1 \\ 0 & n = 0 \text{ and } |n| > 1 \end{cases}$$

Which one of the following is the composite signal $y(n) = x(n) + x(-n)$ for all integer values of n ?

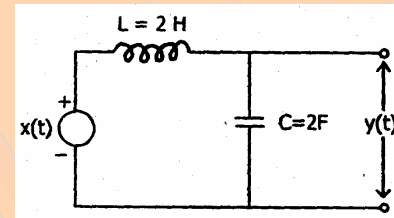
- a. 0
 b. 2
 c. ∞
 d. $-\infty$

22. The relation between input $x(t)$ and output $y(t)$ of a continuous time system is given by : $\frac{dy(t)}{dt} + 3y(t) = x(t)$

What is the forced response of the system when $x(t) = k$ (a constant) ?

- a. k
 b. $k/3$
 c. $3k$
 d. 0

- 23.



$x(t)$: Input voltage

$y(t)$: Output voltage

Consider the circuit shown above

What is the natural response of this system?

- a. A sinusoid with constant amplitude
 b. A growing sinusoid
 c. Zero
 d. A decaying sinusoid

24. A real signal $x(t)$ has Fourier transform $X(f)$. Which one of the following is correct?

- a. Magnitude of $X(f)$ has even symmetry while phase of $X(f)$ has odd symmetry
 b. Magnitude of $X(f)$ has odd symmetry while phase of $X(f)$ has even symmetry
 c. Both magnitude and phase of $X(f)$ have even symmetry
 d. Both magnitude and phase of $X(f)$ have odd symmetry

25. What is the Laplace transform of a delayed unit impulse function $\delta(t-1)$?

- a. 1
 b. zero
 c. $\exp(-s)$
 d. s

26. A discrete-time signal $x[n]$ has Fourier transform $X(e^{j\omega})$.

Match List-I With List-II and select the correct answer using the code given below the lists :

List - I (Signal)

- A. $x[-n]$
- B. $nx[n]$
- C. $x^*[n]$
- D. $x[n-1]$

List - II (Fourier Transform)

- 1. $X^*(e^{-j\omega})$
- 2. $X(e^{-j\omega})$
- 3. $e^{-j\omega}X(e^{j\omega})$
- 4. $j \frac{d}{d\omega} X(e^{j\omega})$

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

27. The outputs of two systems S_1 and S_2 for the same input $x[n] = e^{j\pi n}$ are 1 and $(-1)^n$ respectively. Which one of the following statements is correct?

- a. Both S_1 and S_2 are linear time invariant (LTI) systems
- b. S_1 is LTI but S_2 is not LTI
- c. S_1 is not LTI but S_2 is LTI
- d. Neither S_1 nor S_2 is LTI

28. What is the output as $t \rightarrow \infty$ for a system that has a transfer function $G(s) = \frac{2}{s^2 - s - 2}$ when subjected to a step input?

- a. -1
- b. 1
- c. 2
- d. Unbounded

29. The response of a linear, time-invariant system to a unit step is $s(t) = (1 - e^{-t/RC})u(t)$, where $u(t)$ is the unit Step. What is the impulse response of this system?

- a. $e^{-t/RC}$
- b. $e^{-t/RC} u(t)$
- c. $1/RC \{e^{-t/RC} u(t)\}$
- d. $\delta(t)$

30. What is the Z-transform of the signal $x[n] = \alpha^n u(n)$?

- a. $X(z) = \frac{1}{z-1}$

b. $X(z) = \frac{1}{1-z}$

c. $X(z) = \frac{z}{z-\alpha}$

d. $X(z) = \frac{1}{z-\alpha}$

31. Which one of the following rules determines the mapping of s-plane to z-plane?

- a. Right half of the s-plane maps into outside of the unit circle in z-plane
- b. Left half of the s-plane maps into inside of the unit circle
- c. Imaginary axis in s-plane maps into the circumference of the unit circle
- d. All of the above

32. Algebraic expression for Z transform of $x[n]$ is $X(z)$. What is the algebraic expression for Z transform of $e^{j\omega_0 n} x[n]$?

- a. $X(z-z_0)$
- b. $X(e^{-j\omega_0} z)$
- c. $X(e^{j\omega_0} z)$
- d. $X(z)e^{j\omega_0 z}$

33. Which one of the following is correct? Energy of a power signal is

- a. finite
- b. zero
- c. infinite
- d. between 1 and 2

34. The output of a linear system for any input can be computed in which one of the following ways?

- a. Only by summation of impulse responses by convolution integral
- b. Only by summation of step responses by superposition integral
- c. Neither (a) nor (b)
- d. Using either (a) or (b)

35. Which of the following is/are not a property/properties of a power spectral density function $S_x(\omega)$?

- a. $S_x(\omega)$ is a real function of ω
- b. $S_x(\omega)$ is an even function of ω
- c. $S_x(\omega)$ is a non-positive function of ω i.e. $S_x(\omega) \leq 0$ for all ω
- d. All of the above

36. If a linear time invariant system is excited by a true random signal like white noise, the output of the linear system will have which of the following properties?
- Output will be a white noise
 - Output will be periodic
 - Output will not be random
 - Output will be correlated or colored noise
37. Match List - I with List - II and select the correct answer using the code given below the lists :
- List - I
- Hexagonal crystal
 - Rhombohedral crystal
 - Triclinic crystal
 - Monoclinic crystal
- List - II
- $a = b = c; \gamma = \alpha = \beta \neq 90^\circ$
 - $a = b \neq c; \alpha = \beta = 90^\circ; \gamma = 120^\circ$
 - $a \neq b \neq c; \alpha = \beta \neq \gamma \neq 90^\circ$
 - $a \neq b \neq c; \alpha \neq \gamma \neq 90^\circ \neq \beta$
- | | A | B | C | D |
|----|---|---|---|---|
| a. | 1 | 2 | 3 | 4 |
| b. | 2 | 1 | 4 | 3 |
| c. | 1 | 2 | 4 | 3 |
| d. | 2 | 1 | 3 | 4 |
38. An intense magnetic field is to be produced by a superconducting coil. Which one of the following is essential ?
- The critical temperature T_c must be high so that heating of the coil does not raise the temperature above T_c
 - The magnetic field produced by the current should be less than the critical field
 - The material should be pure so that its high conductivity allows more current to flow through the coil
 - Type I materials should be used so that superconductivity exists below a sharply defined critical field
39. The inductance of a single layer solenoid of 10 turns is 5 μH . Which one of the following is the correct value of inductance when the number of turns is 20 and the length is doubled?
- 10 μH
 - 20 μH
 - 40 μH
 - 5 μH
40. Which one of the following expressions may be used to correctly describe the temperature (T) variation of the intrinsic carrier density (n_i) of a semiconductor?
- $n_i(T) = (A/T) \exp(-E_g/kT^2)$
 - $n_i(T) = A(E_g/kT)^{10}$
 - $n_i(T) = A \exp(-E_g/2kT)$
 - $n_i(T) = AT^{3/2} \exp(-E_g/2kT)$
- E_g is the band gap, A is pre-factor, k is Boltzman constant
41. Which one of the following is the remaining grade of paper used in paper capacitors, besides the other two grades of paper—low loss and extra low loss?
- Strong dielectric
 - Regular
 - Rough
 - High loss
42. Consider the following statements about diamagnetic materials and diamagnetism:
- The materials have negative magnetic susceptibility.
 - At very low temperatures diamagnetic materials are converted into paramagnetic materials.
- Which of the statements given above is/are correct?
- 1 only
 - 2 only
 - Both 1 and 2
 - Neither 1 nor 2
43. Which one of the following is not a characteristic of a ferroelectric material?
- High dielectric constant
 - No hysteresis
 - Ferroelectric characteristic only above the Curie point
 - Electric dipole moment
44. Which one of the following is correct ? Ferrites are particularly suited for high frequency applications because of their
- low distortion
 - high conductivity
 - low eddy current loss
 - high mobility

45. Consider the following statements :
- At finite temperature, magnetic dipoles in a material are randomly oriented giving low magnetization. When magnetic field H is applied, the magnetization
1. increases with H
 2. decreases with H
 3. decreases with temperature for constant H
- Which of the statements given above is/are correct?
- a. 1 only
 - b. 2 only
 - c. 2 and 3
 - d. 1 and 3
46. In highly stable oscillator circuits, AT cut quartz crystals are generally employed. What is the reason for using this particular orientation?
- a. Quartz crystals have a natural growth along this plane
 - b. The corresponding quality factor is largest for this orientation
 - c. There is minimal temperature variation of frequency
 - d. AT cut crystals can be used over a wide frequency range
47. In Curie law for paramagnetic materials, how is the susceptibility χ related to absolute temperature T ?
- a. $\chi \propto T$
 - b. $\chi \propto 1/T$
 - c. $\chi \propto T^2$
 - d. $\chi \propto 1/T^2$
48. What does quality factor of a dielectric mean ?
- a. It is related to the value of permittivity of the material
 - b. It is related to breakdown voltage of the dielectric
 - c. It is related to the resistivity of the material
 - d. It is related to the ratio between maximum stored energy and average power loss in the dielectric
49. The velocity of light in a particular medium is 10^8 m/s. What is the relative permittivity of the medium?
- a. 1.732
 - b. 3
 - c. 9
 - d. 0.333
50. Which one of the following is an example of electroluminescent devices ?
- a. Liquid crystal display and photodiode.
 - b. Liquid crystal display and photo-transistor
 - c. Electroluminescent panel
 - d. Light emitting diode and photo-transistor
51. How much (approximate) is the frequency independent power factor of a plastic dielectric capacitor?
- a. 0.00002
 - b. 0.0002
 - c. 0.002
 - d. 0.02
52. Which among the following has/have capacitance value(s) from few μF to high μF ?
- a. Mica, glass, low loss ceramic
 - b. High permittivity ceramic
 - c. Paper
 - d. Electrolytic
53. An air-filled parallel plate capacitor made of square plates, each $10 \text{ cm} \times 10 \text{ cm}$, has a capacitance C . If the plates are reduced to $2.5 \text{ cm} \times 2.5 \text{ cm}$, what would be the new capacitance?
- a. $C/4$
 - b. $C/8$
 - c. $C/16$
 - d. $C/32$
54. Ceramic resonators use which one of the following?
- a. Barium titanate
 - b. Silicon
 - c. Piezo-electric quartz crystal
 - d. Zirconium titanate
55. Which material is used for making permanent magnet?
- a. Carbon steel
 - b. Germanium
 - c. Silicon
 - d. None of the above

56. Which one of the following measuring devices has minimum loading effect on the quantity under measurement?

- PMMC
- CRO
- Hot wire
- Electrodynamometer

57. A network has 4 nodes and 3 independent loops. What is the number of branches in the network?

- 5
- 6
- 7
- 8

58. Match List - I with List -II and select the correct answer using the code given below the lists:

List - I (Bridge)

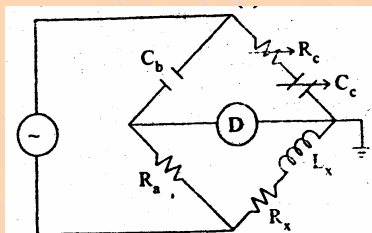
- Wheatstone bridge
- Wien bridge
- Kelvin double bridge
- Schering bridge

List - II (Quantity)

- Capacitance
- Very low resistance
- Resistance
- Frequency

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

59.



The figure shows 'Owen bridge' arranged to measure incremental inductance of the unknown inductance L_x , R_x . At balance, what are the values of L_x and R_x ?

- $L_x = \frac{R_a R_c}{C_b}, R_x = \frac{R_a R_b}{C_c}$
- $L_x = R_a R_c C_b, R_x = R_a C_b C_c$

$$c. L_x = \frac{R_a R_c}{C_b}, R_x = \frac{R_a C_c}{C_b}$$

$$d. L_x = R_a R_c C_b, R_x = \frac{R_a C_b}{C_c}$$

60. Hay bridge is suitable for measuring inductance of which one of the following inductors?

- Having Q value less than 10
- Having Q value greater than 10
- Of any value of Q
- Having phase angle of reactance very large

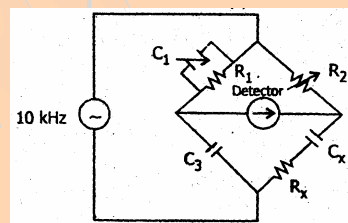
61. The current flowing in a 20Ω resistor is given by:

$$i = 2 + 4 \sin 314 t$$

This current is measured by a hot wire ammeter. What is the measured value?

- 2 A
- 3.46 A
- 4 A
- 2.83 A

62.



The AC bridge is supplied with a source of 10 kHz as shown in the above circuit. What is the value of C_x ?

- $C_3 \frac{R_1}{R_2}$
- $C_3 \frac{R_2}{R_1}$
- $C_3 \frac{R_x}{R_1}$
- $C_3 \frac{R_2}{R_x}$

63. A circle is found on the screen of a CRO when 2 time varying signals of same frequency and same magnitude are applied to X and Y. plates of the CRO. What is the relative phase difference?

- 0°
- 90°

- c. 180°
d. 45°
64. Which of the following A/D converter is used in a Digital Storage Oscilloscope (DSO)?
a. Ramp type
b. Successive approximation type
c. Dual slope type
d. Parallel type
65. It is desired to make accurate measurement of voltage using a CRO. Which of the following items should be taken into consideration in this measurement?
1. Electrostatic deflection type CRT
2. Magnetic deflection type CRT
3. Small deflection for measurement at the centre of the screen
4. Large deflection to cover the entire screen
Select the correct answer using the code given below :
a. 1 and 4
b. 2 and 3
c. 2 and 4
d. 1 and 3
66. Which one of the following is not true of digital instruments ?
a. Loading of the circuit under measurement is less
b. Accuracy is better
c. Free from observational errors
d. Can present the reading in overall context of range
67. Which one of the following statements for a potentiometric transducer is correct?
a. It is a zero order displacement transducer
b. It is a first order displacement transducer
c. It is a zero order temperature transducer
d. It is a second order displacement transducer
68. Which one of the following is correct?
The generated emf of a dc tachogenerator is
a. directly proportional to angular speed
b. inversely proportional to angular speed
c. proportional to square root of angular speed
d. proportional to square of angular speed
69. The best use of a resistance thermometer is in which range?
a. Between 600°C to about 1100°C
b. Between 1100°C to 1400°C
c. Between 1400°C to 1800°C
d. Above 1800°C
70. A strain gauge with a nominal resistance of $120\ \Omega$ and gauge factor of 2 undergoes a strain of 10^{-5} . What is the change in resistance in response to the strain ?
a. $240\ \Omega$
b. $24\ \Omega$
c. $2.4 \times 10^{-3}\ \Omega$
d. $2.4 \times 10^{-2}\ \Omega$
71. A $4\frac{1}{2}$ digit automatic ranging digital voltmeter has a specific accuracy of $\pm 0.05\%$ of reading and $2 \pm 10.2\%$ of range. When the input measured voltage is 22 Volt, what is the overall accuracy ?
a. 0.02%
b. 0.054%
c. 0.077%
d. 0.154%
72. Which one of the following is used to measure temperature inside a boiler furnace?
a. Resistance thermometer
b. Bimetallic thermocouple
c. Optical pyrometer
d. Thermistor
73. An ac LVDT is given 6.3 V input and produces 5.2 V for a range of ± 0.5 inch. When the core is -0.25 inch from the centre, what is the output produced?
a. $-2.0\ \text{V}$
b. $+2.0\ \text{V}$
c. $-2.6\ \text{V}$
d. $+2.6\ \text{V}$
74. Which one of the following transducers cannot measure flow in non-conducting medium?
a. Orifice meter
b. Electromagnetic flow meter
c. Turbine meter
d. Rotameter

75. FM broadcast standards specify a maximum deviation of frequency to be equal to 75 kHz and a maximum modulating frequency of 15 kHz. What is the modulation index for FM wave?
- 1/5
 - 5
 - 60
 - 1125
76. The electron and hole concentrations, n and p respectively obey the relation $np = n_i^2$ where n_i is the intrinsic carrier density. This expression is valid for which of the following?
- For all semiconductors under any condition
 - For- direct band gap semiconductor only
 - For non-degenerate semiconductor under thermal equilibrium condition
 - For degenerate semiconductors having excess electrons and holes
77. Match List - I with List -II and select the correct answer using the code given below the lists :
- List - I (Item)
- Donor energy band
 - Fermi level of p-type semi-conductor at room temperature
 - Acceptor energy band
 - Fermi level in intrinsic semi-conductor
- List - II (Position)
- At the middle of the forbidden energy gap
 - Close to the conduction band
 - Very close to the valence band
 - Close to the valence band
- | | A | B | C | D |
|----|---|---|---|---|
| a. | 4 | 3 | 2 | 1 |
| b. | 1 | 2 | 4 | 3 |
| c. | 4 | 1 | 2 | 3 |
| d. | 2 | 3 | 4 | 1 |
78. Why does the mobility of electrons in a semiconductor decrease with increasing donor density?
- Doping increases the effective mass of electrons
 - Doping decreases the relaxation time of electrons
 - Electrons are trapped by the donors
 - More holes are generated so that the effective mobility decreases
79. The drift velocity of electrons in silicon varies with applied electric field in which one of the ways?
- It monotonically increases with increasing field
 - It first increases linearly, then sub linearly and finally attains saturation with increasing field
 - It first increases, then decreases showing a negative differential region, again increases and finally saturates
 - The drift velocity remains unchanged with increase in field
80. In a homogeneously doped n-type semiconductor bar, holes are injected at one end of the bar. How will the holes flow to the other end?
- By drift mechanism only
 - By diffusion mechanism only
 - By combination of drift and diffusion mechanisms
 - By recombination mechanism
81. The depletion layer in a p-n junction is made of which of the following?
- Ionized donors in p-side and ionized acceptors in n-side
 - Ionized acceptors in p-side and ionized donors in n-side
 - Accumulated holes in p-side and accumulated electrons in n-side
 - Accumulated electrons in p-side and accumulated holes in n-side
82. Which one of the following statements is not correct?
- Reverse saturation current in a BJT approximately doubles for every 10°C rise in temperature
 - The reverse resistance of a junction diode increases with increase in temperature
 - Reverse saturation current of a silicon diode is much smaller than that of a germanium diode.
 - The Cut-in voltage of silicon diode is larger than that of germanium

83. Match List - I with List -II and select the correct answer using the code given below the lists:

List - I (Diode)

- A. Gunn diode
- B. Zener diode
- C. Varactor diode
- D. Schottky diode

List - II (Application)

- 1. Mixer
- 2. Microwave oscillators
- 3. Frequency modulation
- 4. Voltage comparison

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

84. Match List - I with List -II and select the correct answer using the code given below the lists :

List - I (Diode)

- A. Tunnel diode
- B. PIN diode
- C. Zener diode
- D. Photo diode

List -II (Common Application)

- 1. Reading of film sound track
- 2. High frequency oscillator circuits
- 3. Very high frequency switching circuits
- 4. Reference voltage

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

85. For a npn bipolar transistor, what is the main stream of current in the base region?

- a. Drift of holes
- b. Diffusion of holes
- c. Drift of electrons
- d. Diffusion of electrons

86. Which one of the following gain equations is correct for a MOSFET common-source amplifier ? (g_m is mutual conductance, and R_D is load resistance at the drain)

- a. $A_V = g_m / R_D$

- b. $A_V = g_m / R_D$
- c. $A_V = g_m / (1 + R_D)$
- d. $A_V = R_D / g_m$

87. How is an N-channel Junction Field Effect Transistor operated as an amplifier?

- a. With a forward bias gate-source junction
- b. With a reverse bias gate-source junction
- c. With an open gate-source junction
- d. With a shorted gate-source junction

88. The turn-on time of an SCR is 5 microsecond. Its trigger pulse should have which one of the following?

- a. Short rise time with pulse width = $2.5\mu s$
- b. Long rise time with pulse width = $3\mu s$
- c. Short rise time with pulse width = $6\mu s$
- d. Short rise time with pulse width = $5\mu s$

89. Consider the following statements used in respect of the phenomenon-Population Inversion :

- 1. It means population in a higher state is higher than that in a lower state.
- 2. It is observed under thermal equilibrium.
- 3. It increases the rate of spontaneous emission.
- 4. It increases the rate of stimulated emission.

Which of the statements given, above are correct ?

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

90. An intrinsic semiconductor (intrinsic electron density = $10^{16} m^{-3}$) is doped with donors to a level of $10^{22} m^{-3}$. What is the hole density assuming all donors to be ionized ?

- a. $10^7 m^{-3}$
- b. $10^8 m^{-3}$
- c. $10^{10} m^{-3}$
- d. $10^6 m^{-3}$

91. A Si sample is doped with a fixed number of group V impurities. The electron density n is measured from 4 K to 1200 K

for the sample. Which one of the following is correct?

- n remains constant over the temperature range
- n increases monotonically with increasing temperature
- n increases first, remains constant over a range and again increases with increasing temperature
- n increases, shows a peak and then decreases with rise in temperature

92. An n-type semiconductor is illuminated by a steady flux of photons with energy greater than the band gap energy. The change in conductivity $\Delta \sigma$ obeys which relation?

- $\Delta \sigma = 0$
- $\Delta \sigma = e(\mu_n + \mu_p) \Delta n$
- $\Delta \sigma = e(\mu_n \Delta n - \mu_p \Delta p)$
- $\Delta \sigma = e \mu_n \Delta n$

93. For a semi-conductor, the conductivity is a function of the products of the number of charge carriers and their mobilities. As a result, if the temperature of a slab of intrinsic silicon increases, how does its conductivity vary ?

- Decreases
- Increases
- Remains unaffected
- Increases or decreases depending upon the rise in temperature

94. The electric field intensity \vec{E} at a point P is given by:

$10\hat{i} + 10\hat{j} + 10\hat{k}$ where \hat{i} , \hat{j} and \hat{k} are unit vectors in x, y and z directions respectively. If α , β , γ are respectively the angles the \vec{E} vector makes with x, y and z axes respectively, they are given by which of the following?

- $\alpha = \beta = \gamma = 30^\circ$
- $\alpha = \beta = \gamma = 60^\circ$
- $\alpha = \beta = \gamma = \cos^{-1} \frac{1}{\sqrt{3}}$
- $\alpha = \beta = \gamma = \cos^{-1} \frac{1}{3}$

95. What is the magnetic field intensity vector \vec{H} between two parallel sheets with

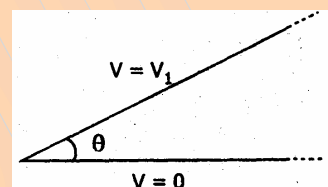
separation 'd' along z-axis both sheets carrying surface current $\vec{k} = k_y \vec{a}_y$?

- $-k_y \vec{a}_y$
- $+k_y \vec{a}_y$
- $+k_y \vec{a}_x$
- zero

96. W_1 is the electrostatic energy stored in a system of three equal point charges arranged in a line with 0.5 m separation between them. If W_2 is the energy stored with 1 m separation between them, then which one of the following is correct?

- $W_1 = 0.5 W_2$
- $W_1 = W_2$
- $W_1 = 2 W_2$
- $W_1 = 4 W_2$

97.



The potential distribution V between two infinite flat metal sheets meeting at an angle θ is to be found. The left edges of the sheets are separated by an infinitesimal gap. The lower sheet is at zero potential and the upper sheet is at potential V_1 . If α be an angle from $V = 0$ plate, what is the potential distribution?

- $V = V_1 \sin\left(\frac{\pi\alpha}{2\theta}\right)$
- $V = V_1 \sin\left(\frac{2}{2\theta}\right)$
- $V = V_1 \sin\left(\frac{3\pi\alpha}{2\theta}\right)$
- $V = V_1 \sin\left(\frac{\alpha}{\theta}\right)$

98. What is the value of the magnetic vector potential due to an infinitesimally small current element, evaluated at infinite distance from it?

- Infinity
- Unity
- Zero

- d. Any number between zero and infinity depending on the strength of the current element
99. Application of the method of images to a boundary value problem in electrostatics involves which one of the following?
- Introduction of an additional distribution of charges and removal of a set of conducting surfaces
 - Introduction of an additional distribution of charges and an additional set of conducting surfaces
 - Removal of a charge distribution and introduction of an additional set of conducting surfaces
 - Removal of a charge distribution as well as a set of conducting surfaces
100. Magnetic current is composed of which of the following?
- Only conduction component
 - Only displacement component
 - Both conduction and displacement components
 - Neither conduction component nor displacement component
101. Two conducting thin coils X and Y (identical except for a thin cut in coil Y) are placed in a uniform magnetic field which is decreasing at a constant rate. If the plane of the coils is perpendicular to the field lines, which of the following statements is correct? As a result, emf is induced in
- both the coils
 - coil, Y only
 - coil X only
 - none of the two coils
102. Which one of the following is correct? As frequency increases, the surface resistance of a metal
- decreases
 - increases
 - remains unchanged
 - varies in an unpredictable manner
103. Match List - I with List - II and select the correct answer using the code given below the lists :
- List - I (Frequency Range)
- A. 20–100 kHz

- B. 100–535kHz
- C. 535–1600 kHz
- D. 1.6–30 MHz

List - II (Wave Characteristic)

- Due to high absorption in day time, long distance communication by sky wave is not possible
- Day time broadcasting depends entirely on ground wave propagation
- Mostly ground waves up to 1000 km
- Mostly sky waves

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

104. If $\vec{E} = \left(\hat{x} + j \hat{y} \right) e^{-j\beta z}$, then the wave is said to be which one of the following?

- Right circularly polarized
- Right elliptically polarized
- Left circularly polarized
- Left elliptically polarized

105. Which one of the following statements is correct?

On a conducting surface boundary, electric field lines are

- always tangential
- always normal
- neither tangential nor normal
- at an angle depending on the field intensity

106. Which one of the following statements for a short circuited loss free line is not correct?

- The line appears as a pure reactance when viewed from the sending end
- It can be either inductive or capacitive
- There are no reflections in the line
- Standing waves of voltage and current are set up along length of the lines

107. Match List - I with List - II and select the correct answer using the code given below the lists :

List - I (Load Impedance)

- A. Short Circuit
- B. Open Circuit

C. Line characteristic impedance

D. $2 \times$ line characteristic impedance

List -II (Value of Reflection Coefficient)

1. 0
2. -1
3. +1
4. +1/3

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

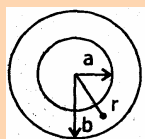
108. When the reflection coefficient equals $1 \angle 0^\circ$, what is the VSWR?

- a. Zero
- b. 1
- c. 3
- d. Infinite

109. Match List - I with List - II and select the correct answer using the code given below the lists :

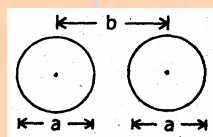
List - I (Transmission Line)

A.



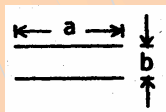
Coaxial line

B.



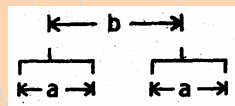
Two wire line

C.



Parallel plate line

D.



Collinear plate

List -II (Characteristic Impedance)

1. $R_0 = \frac{\eta b}{a}, a \gg b$
2. $R_0 = \frac{\eta}{\pi} \ln\left(\frac{4b}{a}\right), b \gg a$

$$3. R_0 = \frac{\eta}{2\pi} \ln(b/a)$$

$$4. R_0 = \frac{\eta}{\pi} \ln\left(\frac{2b}{a}\right), b \gg a$$

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

110. Match List - I with List - II and select the correct answer using the code given below the lists :

List - I (Component)

- A. Coaxial line
- B. Rectangular waveguide
- C. Cavity resonator
- D. Common wavemeter

List - II (Filtering Characteristics)

1. Band pass filter
2. Band reject filter
3. Low pass filter
4. High pass filter

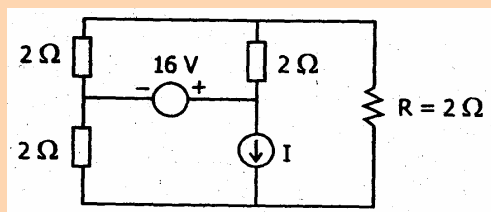
	A	B	C	D
a.	1	2	3	4
b.	1	2	4	3
c.	3	4	2	1
d.	3	4	1	2

111. A broadside array of four isotropic point sources of same amplitude and phase, placed along x axis with a spacing of $\lambda/2$ between adjacent elements has a polar pattern consisting of which of the following?

- a. One major lobe in the +ve y direction and one major lobe in the negative y direction and no side lobes
- b. One major lobe in the +ve y direction, one major lobe in the negative y direction, one minor lobe in the +ve x direction and one minor lobe in the -ve x direction
- c. One major lobe in the +ve y direction, one major lobe in the negative y direction, one minor lobe in each of the four quadrants
- d. Four major lobes one each in +y; -y; +x and -x directions and no other side lobes

112. Which one of the following is correct?
Normal mode helical antenna has
- low radiation efficiency and high directive gain
 - high radiation efficiency and low directive gain
 - low radiation efficiency and low directive gain
 - high radiation efficiency and high directive gain
113. Which one of the following causes phase shift through an op-amp?
- Internal RC circuits
 - External RC circuits
 - Gain roll off of the internal transistor
 - Negative feedback

114.



In the circuit shown above, if the current through the resistor R is zero, what is the value of I ?

- 1 A
 - 2 A
 - 3 A
 - 4 A
115. Which one of the following is correct ?
A system can be completely described by a transfer function if it is
- non-linear and continuous
 - linear and time-varying
 - non-linear and time-invariant
 - linear and time-invariant
116. Assertion (A) : A super conductor is a perfect diamagnetic material.
Reason (R) : A super conductor is a perfect conductor.
- 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

117. Assertion (A) : If a piece of metal is made to have a temperature gradient between its two ends, an emf exists between these ends.

Reason (R) : Electrons at the hot end move towards the cold end.

- 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
118. Assertion (A) : A heavily doped semiconductor can exhibit positive temperature coefficient of resistance.
Reason (R) : The carrier mobility decreases with increase of temperature.
- 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
119. Assertion (A) : The resistors and capacitors fabricated using IC technology have poor tolerances with respect to their absolute values.
Reason (R) : As all the components of the IC are fabricated simultaneously, their ratio of tolerances is very low.
- 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
120. Assertion (A) : Substrates chosen for fabrication of microstrip lines are usually thin and having high value of dielectric constant.
Reason (R) : To minimize radiation loss from microstrip lines, fringing of fields must be reduced as much as practicable.
- 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