# ELECTRONICS & TELECOMMUNICATION ENGINEERING

PAPER-I

1.
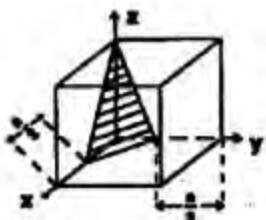
Each side of the cube shown above is of length a. What are the Miller indices of the shaded surface?

a. (100)

b. (123)

c. (221)

d. $\left(\frac{1}{2}\frac{1}{2}1\right)$

2. Consider the following statements with regard to FCC structure :

1. Number of nearest neighbour atoms is twelve.

2. Packing efficiency is 0.74.

3. There is an atom at the body centre of the unit cell.

Which of the statements given above is/are correct?

a. 1, 2 and 3

b. 1 and 2

c. 2 and 3

d. 1 and 3

3. Consider the following statements in respect of graphite:

1. It has three coplanar covalent bonds.

2. It has good electrical and thermal conductivity.

3. Sheets of graphite are held together by van der Waal's interaction.

Which of the statements given above is/are correct?

a. 1, 2 and 3

b. 1 and 2

c. 2 and 3

d. 1 and 3

4. Which one of the following exhibits the most well-defined X-ray diffraction pattern?

a. A polycrystalline aggregate

b. An amorphous material

c. A single crystalline material

d. A plastically deformed crystal

5. The mobility of electrons in a semiconductor is defined as the

a. Diffusion velocity per unit electric field

b. Diffusion velocity per unit magnetic field

c. Drift velocity per unit magnetic field

d. Drift velocity per unit electric field

6. The free electron density in a conductor is $(1/1.6) \times 10^{22}$ cm^{-3}. The electron mobility is 10 cm^2/Vs. What is the value of its resistivity?

a. 10^{-4} Ω m

b. 16×10^{-2} Ω m

c. 10^{-4} Ω m

d. 10^4 mho cm^{-1}

7. The intrinsic concentration in a semiconductor at 300 K is 10^{13} cm^{-3}. When it is doped with donor type impurities, the majority carrier concentration becomes 10^{17} cm^{-3}. What is the value of its minority carrier density?

a. 0.999×10^{17} cm^{-3}

b. 10^{17} cm^{-3}

c. 10^4 cm^{-3}

d. 10^9 cm^{-3}

8. Which one of the following is the correct relationship between the band gap of a material used in a photo detector and the energy of the incident photon?

a. $E_g \geq hc/\lambda$

b. $h\upsilon^2/\lambda \geq E$

c. $h\upsilon \geq E_g$

d. $1/2 \, h\upsilon \leq E_g$

(the symbols have usual meanings)

9. When does $BaTiO_3$ lose its ferroelectric properties?
   a. Above 0° K
   b. Above its Curie point
   c. Above room temperature
   d. Above its melting point

10. Magnetic cores required for RF applications have
    a. High hysteresis and eddy current losses
    b. High hysteresis and low eddy current losses
    c. Low hysteresis and high eddy current losses
    d. Low hysteresis and eddy current losses

11. At what condition of surrounding air, does electrochemical breakdown occur?
    a. High temperature and high humidity
    b. High temperature and low humidity
    c. Low temperature and high humidity
    d. Low temperature and low humidity

12. Which one of the following correctly represents the variation of critical magnetic field (H_C) with temperature for a superconductor?

    a.
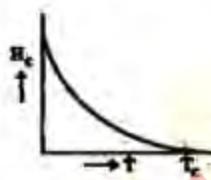
    b.
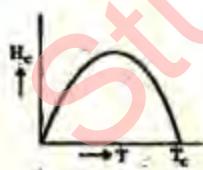
    c.
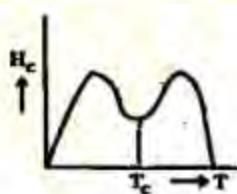
    d.
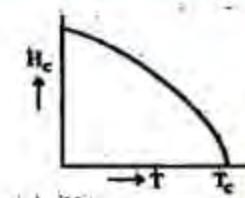
13. Ferrites are the materials which have
    a. Low permeability and low dielectric loss
    b. Low permeability and high dielectric loss
    c. High permeability and low dielectric loss
    d. High permeability and high dielectric loss

14. Which one of the following correctly depicts the V-I characteristics of typical bead thermistor?

    a.
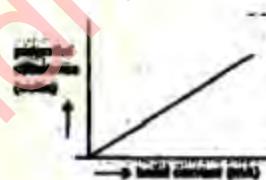
    b.
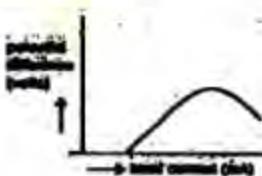
    c.
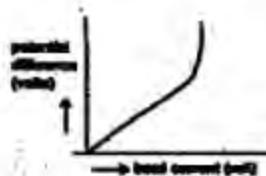
    d.
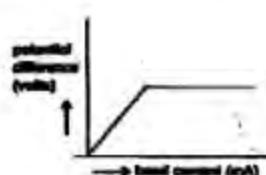
15. Consider the following statements:
    1. Diamagnetic susceptibility is very large.
    2. Diamagnetic susceptibility is negative.
    3. Diamagnetic susceptibility is independent of temperature.

4. Diamagnetic susceptibility is additive.

Which of the statements given above is/are correct ?

a. 1, 2 and 3

b. 2 and 4

c. 2, 3 and 4

d. 3 only

16. Metal film resistors are made by depositing a very thin layer of metal on a

a. Metal rod

b. Bakelite sheet

c. Ceramic rod

d. Metal sheet

17. A thin resistive film having length (1), width (w) and thickness (t) is used as a resistor (R_1) for conducting current in the direction of l. If the film is connected to serve as a resistor (R_2) for conducting current in the direction of w, then what is the value of R_1/R_2 ?

a. l/w

b. w/l

c. l^2/w^2

d. w^2/l^2

18. The relative dielectric constant of Al_2O_3 is 8. The dielectric constant of free space is 8.854×10^{-12} f/m. What is the capacitance of a layer of Al_2O_3 which is 0.5×10^{-6} metre thick and has 1000 mm² of surface area?

a. 7.08×10^{-7} f

b. 1.42×10^{-7} f

c. 2.83×10^{-7} f

d. 0.92×10^{-7} f

19. How can eddy current loss in the core of a transformer be minimized?

1. By increasing the resistivity of the core.

2. By using the laminated sheets with insulator coatings.

3. By using highly insulating non-magnetic material for the core.

4. By using the paramagnetic material as the core.

Select the correct answer using the code given below :

a. 1 and 2

b. 2 and 3

c. 1 and 3

d. 1, 2 and 4

20. Two pure specimen of a semiconductor material are taken. One is doped with 10^{18} cm⁻³ number of donors and the other is doped with 10^{16} cm⁻³ number of acceptors. The minority carrier density in the first specimen is 10^7 cm⁻³. What is the minority carrier density in the other specimen?

a. 10^{16} cm⁻³

b. 10^{27} cm⁻³

c. 10^{18} cm⁻³

d. 10^9 cm⁻³

21. Match List I (Type of Conductor) with List II (Position of Fermi Level) and select the correct answer using the code given below:

List I

A. n-type semiconductor

B. p-type semiconductor

C. Intrinsic semiconductor

D. Degenerate n-type semiconductor

List II

1. Middle of band gap

2. Above conduction band

3. Near but below conduction band

4. Near but above valence band

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

22. Diffusion of impurities in a semiconductor is carried out in a furnace through which a steady stream of impurity atoms is passed during the entire diffusion process. What would be the type of the profile of the impurity atoms inside the semiconductor?

a. Linear

b. Gaussian

c. Complementary error function

d. Exponential

23. A tunnel diode is

a. High resistivity p-n junction diode

b. A slow switching device

c. An amplifying device

d. A very heavily doped p-n junction diode

24. Match List I (Semiconductor Device) with List II (Symbol Used) and select the correct answer using the code given below:

List I

A. n-p-n transistor

B. SCR

C. FET

D. MOSFET

List II

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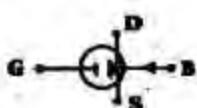
2.
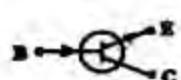
3.
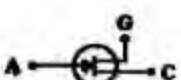
4.
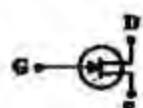
	A	B	C	D
a.	2	3	4	1
b.	4	1	2	3
c.	2	1	4	3
d.	4	3	2	1

25. Match List I (Isolation Technique in IC) with List II (Related Characteristic) and select the correct answer using the code given below:

List I

A. Reverse bias p-n junction isolation

B. Resistive isolation using the bulk resistivity of the layer

C. Native oxide isolation

D. Oxide (other than native isolation)

List II

1. Requires large area of the wafer, thereby increasing the IC size

2. Best choice for silicon ICs with low parasitic capacitance

3. Suitable for ICs of III-V semiconductors

4. Introduces bias-dependent parasitic capacitance

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

26. Which one of the following statements is correct in respect of the use of Direct Gap (DG) and Indirect Gap (IG) semiconductors in fabrication of Light Emitting diode?

a. Both DG and IG semiconductors are suitable

b. Only DG semiconductor is suitable

c. DG semiconductor is suitable and some IG materials having proper dopants are also used

d. Only IG semiconductors are suitable

27. Which of the following are the advantages of a fibre optic link over a conventional copper wire link?

1. A fibre optic link has greater bend-width.

2. A fibre optic link has lower cost.

3. A fibre optic link is immune to cross link.

4. A fibre optic link is easy to split.

Select the correct answer using the code given below:

a. 1 and 2

b. 1 and 3

c. 2 and 3

d. 1 and 4

28. A hetero-structure laser is better than a diode laser (injection laser) because of its

a. Low cost

b. Long wavelength emission

c. Low threshold current

d. Non-linear operation

29. Consider the following statements in relation to a semiconductor laser diode :

1. The material should be a direct gap semiconductor.

2. Some form of wavelength selective structure or resonator must be present.

3. Light output increases linearly with bias current.

4. Light output increases significantly when bias current exceeds a threshold value.

Which of the statements given above are correct?

a. 1, 2 and 4

b. 1 and 3

c. 2 and 4

d. 2 and 3

30. Consider the following statements related to a CMOS (Complementary metal oxide semiconductor) inverter:

1. It combines an n-channel and a p-channel MOS transistor.

2. For binary 1 input, both transistors are OFF.

3. For binary 0 input, both transistors are ON.

4. Whatever is the state of input, one transistor is ON while the other is OFF.

Which of the statements given above are correct?

a. 1, 2, 3 and 4

b. 1 and 4

c. 1, 2 and 3

d. 3 and 4

31. Consider the following statements :

X-rays are used for lithography in IC technology because

1. high resolution is achievable.

2. scattering effects are small.

3. they can be focused easily.

4. they can be deflected easily.

Which of the statements given above are correct?

a. 1 and 2

b. 1 and 3

c. 1 and 4

d. 2 and 3

32. The basic function of buried n^+ layer in an n-p-n transistor in IC is to

a. Reduce the magnitude of the base spreading resistance

b. Reduce the collector series resistance

c. Reduce the base width of the transistor

d. Increase the gain of the transistor

33. In an SCR circuit, the anode is grounded. The voltages at the gate and cathode at a particular working condition are measured to be –50 V and –55 V, respectively. Based on this observation, it could be inferred that

a. The SCR is in forward blocking mode

b. The SCR is in forward conducting mode

c. The SCR is in reverse blocking mode

d. The SCR is damaged

34. Match List I (Semiconductor Device) with List II (Application) and select the correct answer using the code given below :

List I

A. Triac

B. IGBT

C. SCR

D. UJT

List II

1. Used in HVDC system

2. Used in pulse generation

3. Used in motor control circuits

4. Used in fan regulators

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

35. Which one of the following is the exact expression for I_{CEO} (i.e. collector to emitter current with base open) in a junction transistor?

a. $\alpha.I_{CBO}$

b. $\dfrac{\alpha}{1-\alpha}.I_{CBO}$

c. $\dfrac{I_{CBO}}{1-\alpha}$

d. $(1-\alpha)I_{CBO}$

(where I_{CBO} is the collector to base current with emitter open, and α is the common base current gain)

36. A MOSFET device has both n^+- type source and drain, and the drain current flows only when gate to source voltage exceeds +2.0 V. Which of the following conclusions can be drawn about the device?

 1. The device is an n-channel MOSFET
 2. It is enhancement type MOSFET
 3. It has threshold voltage of value +2.0V
 4. The channel conductance is determined by hole mobility

Select the correct answer using the code given below:

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

37. The junction capacitance of a p-n junction depends on

 a. Doping concentration only
 b. Applied voltage only
 c. Both doping concentration and applied voltage
 d. Barrier potential only

38. Which of the following pairs is not correctly matched?

 a. The typical temperature range over which Germanium transistors are operated : $-65°C$ to $175°C$
 b. In a CE amplifier thermal runaway is unconditionally avoided if : $V_{CE} < V_{CC}/2$
 c. The current gain of amplifier stage is lowest in : CB configuration
 d. The voltage gain of amplifier stage is lowest in : CC configuration

39. A signal $v(n)$ is defined by

$$v[n] = \begin{cases} 1 & ; & n=1 \\ -1 & ; & n=-1 \\ 0 & ; & n=0 \text{ and } |n|>1 \end{cases}$$

Which is the value of the composite signal defined as $v[n] + v[-n]$?

 a. 0 for all integer values of n
 b. 2 for all integer values of n
 c. 1 for all integer values of n
 d. -1 for all integer values of n

40. The lengths of two discrete time sequence $x_1(n)$ and $x_2(n)$ are 5 and 7, respectively. What is the maximum length of a sequence $x_1(n) * x_2(n)$?

 a. 5
 b. 6
 c. 7
 d. 11

41. The governing differential equations connecting the output $y(t)$ and the input $x(t)$ of four continuous time systems are given in the List I and List II respectively. Match list I (Equation) with List II (System Category and select the correct answer using the code given below :

List I

 A. $2t\dfrac{dy}{dt} + 4y = 2tx$

 B. $y\dfrac{dy}{dt} + 4y = 2x$

 C. $4\dfrac{d^2 y}{dt^2} + 2\dfrac{dy}{dt} + y = 3\dfrac{dx}{dt}$

 D. $\left(\dfrac{dy}{dt}\right)^2 + 2ty = 4\dfrac{dx}{dt}$

List II

 1. Linear, time-invariant and dynamic
 2. Non-linear, time-invariant and dynamic
 3. Linear, time-variable and dynamic
 4. Non-linear, time-variable and dynamic
 5. Non-linear, time-invariant and non-dynamic

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

42.
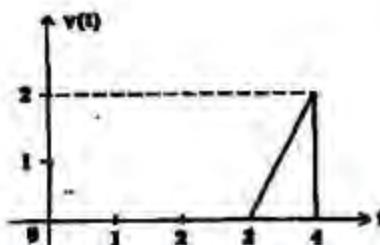
In the graph shown above, which one of the following expresses v(t) ?

a. $(2t + 6) [u(t-3) + 2u(t-4)]$

b. $(-2t - 6)[u(t-3) + u(t-4)]$

c. $(-2t + 6)[u(t-3) + u(t-4)]$

d. $(2t - 6)[u(t-3) - u(t-4)]$

43. Consider the following statements about linear time- invariant (LTI) continuous time systems :

1. The output signal in an LTI system with known input & known impulse response can always be determined.

2. A causal LTI system is always stable.

3. A stable LTI system has an impulse response, h(t) which has a finite value when integrated over whole of the time axis, i.e. $\int_{-\infty}^{+\infty} h(\lambda)d\lambda$ is finite.

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

44. The unit sample response of a discrete system is 1 1/2 1/4 0 0 0 ...., For an input sequence 1 0 1 0 0 0 ......, what is the output sequence?

a. 1 1/2 1/4 1/2 1/4 0 0 ...

b. 1 0 1/4 0 0 ...

c. 2 1/2 5/4 0 0 ...

d. 1 1/2 5/4 1/2 1/4 0 0 ...

45. What one of the following represents the phase response of the function :

$$H(s) = \frac{s^2 + \omega_0^2}{s^2 + (\omega_0 / Q)s + \omega^2} ?$$

a.
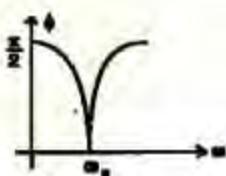
b.
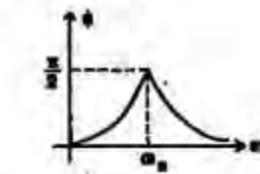
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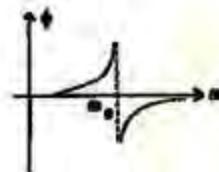
d.
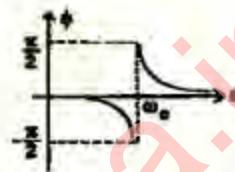
46. What does the transfer function of a system describe for the system?

a. Only zero-input response

b. Only zero-state response

c. Both zero-input and zero-state responses

d. Neither zero-input response nor zero-state response

47. Match List I (Time Function) with List II (Fourier Spectrum/Fourier Transform) and select the correct answer using the code given below the Lists:

List I

A. Periodic Function

B. A periodic Function

C. Unit Impulse $\delta(t)$

D. $\sin \omega(t)$

List II

1. Continuous spectrum at all frequencies

2. $\delta(\omega)$

3. Line discrete spectrum

4. 1

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

48.
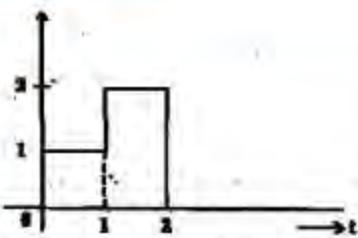
What is the Laplace transform of the waveform shown above?

a. $F(s) = \dfrac{1}{s} + \dfrac{1}{s}e^{-s} - \dfrac{2}{s}e^{-2s}$

b. $F(s) = \dfrac{1}{s} - \dfrac{1}{s}e^{-s} + \dfrac{2}{s}e^{-2s}$

c. $F(s) = \dfrac{1}{s} + \dfrac{1}{s}e^{s} + \dfrac{2}{s}e^{2s}$

d. $F(s) = \dfrac{1}{s} - \dfrac{1}{s}e^{-s} - \dfrac{2}{s}e^{-2s}$

49.
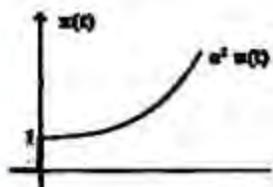
For the signal shown above :

a. Only Fourier transform exists
b. Only Laplace transform exist
c. Both Laplace and Fourier transforms exist
d. Neither Laplace nor Fourier transform exists

50. Let $x[n] = a^n u[n]$ $h[n] = b^n u[n]$
What is the expression for y[n], for a discrete-time system?

a. $\displaystyle\sum_{k=-\infty}^{\infty} a^k u[k] b^{n-k} u[n-k]$

b. $\displaystyle\sum_{k=-\infty}^{\infty} a^n u[k] b^{n-k} u[n-k]$

c. $\displaystyle\sum_{k=-\infty}^{\infty} a^n u[n-k] b^n u[k]$

d. $\displaystyle\sum_{k=-\infty}^{\infty} a^{n-k} u[k] b^{n-k} u[n-k]$

51. The output y[n] of a-discrete time LTI system is related to the input x[n] as given below :

$$y[n] = \sum_{k=0}^{\infty} x[k]$$

Which one of the following correctly relates the z-transforms of the input and output, denoted by X(z) and Y(z), respectively?

a. $Y(z) = \left(1 - z^{-1}\right) X(z)$

b. $Y(z) = z^{-1} X(z)$

c. $Y(z) = \dfrac{X(z)}{1 - z^{-1}}$

d. $Y(z) = \dfrac{dX(z)}{dz}$

52. A signal represented by $x(t) = 5 \cos 400 \pi t$ is sampled at a rate 300 samples/s. The resulting samples are passed through an ideal low pass filter of cut-off frequency 150 Hz. Which of the following will be contained in the output of the LPF?

a. 100 Hz
b. 100 Hz, 150 Hz
c. 50 Hz, 100 Hz
d. 50 Hz, 100 Hz, 150 Hz

53. Match List I (Discrete lime Signal) with List II (Transform) and select the correct answer using the code given below the Lists:

List I

A. Unit step function
B. Unit impulse function
C. $\sin \omega t$, $t = 0, T, 2T$
D. $\cos \omega t$, $t = 0, T, 2T$

List II

1. 1

2. $\dfrac{z - \cos \omega T}{z^2 - 2z \cos \omega T + 1}$

3. $\dfrac{z}{z-1}$

4. $\dfrac{z - \sin \omega T}{z^2 - 2z \cos \omega T + 1}$

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

54. Which one of the following is the inverse z-transform of :

$$X(z) = \frac{z}{(z-2)(z-3)} \quad |z| < 2 ?$$

a. $[2^n - 3^n] u(-n-1)$
b. $[3^n - 2^n] u(-n-1)$
c. $[2^n - 3^n] u(n+1)$
d. $[2^n - 3^n] u(n)$

55. The auto-correlation function $R_x(\tau)$ of a random process has the property that $R_x(0)$ is equal to:

a. The square of the mean value of the process
b. The mean squared value of the process
c. The smallest value of $R_x(\tau)$
d. $\frac{1}{2}[R_x(\tau) + R_x(-\tau)]$

56.
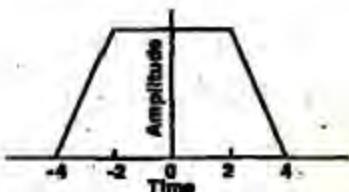
The graph shown above represents a waveform obtained by convolving two rectangular waveforms of duration:

a. Four units each
b. Four and two units respectively
c. Six and three units respectively
d. Six and two units respectively

57. The discrete time Fourier transform (DTFT) of $x[n] = 2(3)^n u[-n]$ is equal to :

a. $\dfrac{2}{1 - e^{j\Omega/3}}$
b. $\dfrac{2}{1 + e^{j\Omega/3}}$
c. $2\left(\dfrac{1 + e^{j\Omega/3}}{1 - e^{j\Omega/3}}\right)$
d. $2\left(\dfrac{1 - e^{j\Omega/3}}{1 + e^{j\Omega/3}}\right)$

58.
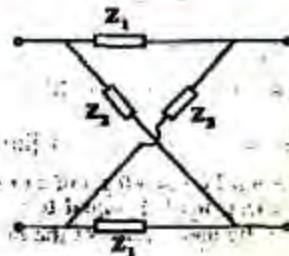
What is the expression for h_{12} in respect of the network shown above?

a. $\dfrac{z_3 - z_1}{z_1 + z_2}$
b. $\dfrac{z_1 + z_2}{z_3 - z_1}$
c. $\dfrac{z_1 + z_2}{z_3 - z_2}$
d. $\dfrac{z_3 - z_1}{z_1 + z_2}$

59. If a unit step current is passed through a capacitor what will be the voltage across the capacitor?

a. 0
b. A step function
c. A ramp function
d. An impulse function

60. Two two-port networks are connected in parallel. The combination is to be represented as a single two-port network. The parameters of this network are obtained by addition of the individual :

a. z-parameters
b. h-parameters
c. y-parameters
d. ABCD parameters

61.
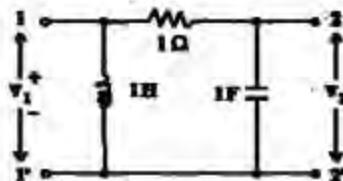
For the network shown above, Match List I (y-parameter) with List II (Value) and select the correct answer using the code given below the Lists:

List I

A. y_{11}

B. y_{12}

C. $y_{22} - y_{21}$

D. y_{22}

List II

1. $s + 1$
2. -1
3. $1 + 1/s$
4. s

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

62. Consider the following statements :

Superposition theorem is applicable to a linear network in determining

1. the current responses.
2. the voltage responses.
3. the power responses.

Which of the statements given above are correct?

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

63. If two identical 3 A, 4 Ω Norton equivalent circuits are connected in parallel with like polarity the combined Norton equivalent circuit will be:

a. 3A, 8Ω
b. 6A, 8Ω
c. 0A, 2Ω
d. 6A, 2Ω

64.
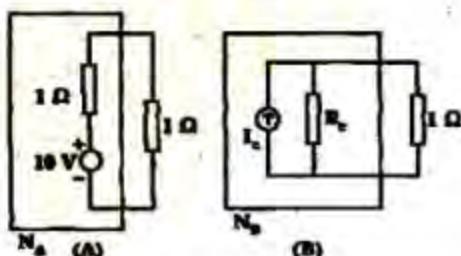
Consider the following statements:

Network N_A in figure (A) can be replaced by the network N_B shown in figure (B) above, when I_C and R_C respectively, are :

1. 5 A and 2 Ω
2. 10 A and 1 Ω
3. 15 A and $\frac{1}{2}$ Ω
4. 30 A and $\frac{1}{5}$ Ω

Which of the following statements given above is/are correct?

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

65.
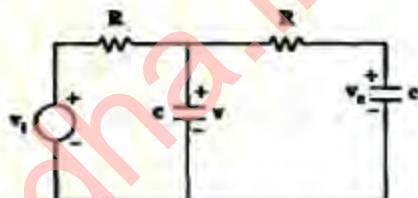
For the circuit given above, what is the expression for the voltage v ?

a. $v_i + v_c$
b. v_c
c. $RC \dfrac{dv_c}{dt} - v_s$
d. $RC \dfrac{dv_c}{dt} + v_s$

66. Consider the following properties of a particular network theorem :

1. The theorem is not concerned with type of elements.
2. The theorem is only based on the two Kirchoff's laws.
3. The reference directions of the branch voltages and currents are arbitrary except that they have to satisfy Kirchoff's laws.

Which one of the following theorems has the above characteristics?

a. Thevenin's theorem
b. Tellegen's theorem
c. Norton's theorem
d. Superposition theorem

67. For a network of 11 branches and 6 nodes, what is the number of independent loops?

a. 4

b. 5

c. 6

d. 11

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

a. A tree contains all the vertices of its graph

b. A circuit contains all the vertices of its graph

c. The number of f-circuits is the same as the number of chords

d. There are at least two edges in a circuit

69. An RLC series circuit has a resistance R of 20 Ω and a current which lags behind the applied voltage by 45°. If the voltage across the inductor is twice the voltage across the capacitor, what is the value of inductive reactance?

a. 10 Ω

b. 20 Ω

c. 40 Ω

d. 240 Ω

70. R and C are connected in parallel across a sinusoidal voltage source of 240 V. If the currents through the source and the capacitor are 5A and 4A, respectively, what is the value of R?

a. 24 Ω

b. 48 Ω

c. 80 Ω

d. 240 Ω

71. A parallel circuit consists of two branches : one with a pure capacitor and the other has resistor of 5 Ω in series with a variable inductor. To this circuit an ac voltage of fixed value and frequency is connected. The circuit will exhibit two resonances if :

a. The reactance of the capacitor is less than 10 Ω

b. The reactance of the capacitor is greater than 10 Ω

c. The reactance of the capacitor equals 10 Ω

d. The capacitor is removed by a short circuit

72. In a series RLC circuit, the locus of the tip of the admittance phasor in the complex plane as the frequency is varied, is:

a. A semicircle in the upper half of the G-B plane having the centre at $\left(\frac{1}{R}, 0\right)$ and radius $\frac{1}{R}$

b. A circle in the upper half of the G-B plane having the centre at $\left\{\frac{1}{(2R)}, 0\right\}$ and radius $\frac{1}{(2R)}$

c. A semicircle in the bottom half of the G-B plane having the centre at $\left\{\frac{-1}{(2R)}, 0\right\}$ and radius $\frac{1}{(2R)}$

d. A semicircle in the upper half of the G-B plane having the centre at $\left(-\frac{1}{R}, 0\right)$ and radius $\frac{1}{R}$

73.
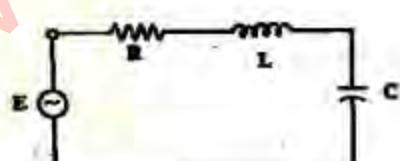
Which one of the following statements is not correct for the circuit shown above at resonant frequency?

a. The current is maximum

b. The equivalent impedance is real

c. The inductive and capacitive reactances are equal in magnitude

d. The quality factor equals $\frac{1}{R}\sqrt{\frac{C}{L}}$

74. A parallel circuit has two branches. In one branch, R and L are in series and in the other branch, R and C are in series. The circuit will exhibit unity power factor when :

a. $R = \sqrt{\frac{L}{C}}$

b. $R = \sqrt{LC}$

c. $R = \sqrt{\frac{C}{L}}$

d. $R = \frac{L}{C}$

d. $\frac{J_0}{2\pi r}(r^3 - a^3)$

75.
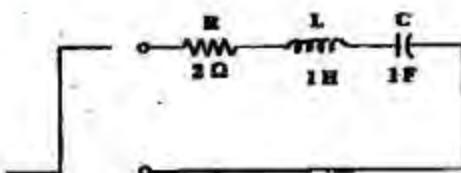
A step voltage is applied to the circuit shown above. What is the transient current response of the circuit?

a. Undamped sinusoidal
b. Overdamped
c. Underdamped
d. Critically damped

76. The capacitance of a parallel plate capacitor is given by $\varepsilon_0 \varepsilon_r (A/d)$ where A is the area of each plate and d is the distance between the plates. Considering fringing field, under which one of the following conditions is the above expression valid?

a. $\frac{A}{d}$ is tending towards zero

b. $\frac{A}{d}$ is tending towards infinity

c. $\frac{A}{d}$ is 1

d. $\frac{A}{d}$ is $\frac{1}{\varepsilon_r \varepsilon_0}$

77. Current density $(\bar{J})$, in cylindrical co-ordinate system is given as :

$J(r, \theta, z) = 0$ for $0 < r < a$

$= J_0(r/a^2)\, \bar{i}_z$ for $a < r < b$

Where $\bar{i}_z$ is the unit vector along z-coordinate axis. In the region, $a < r < b$, what is the expression for the magnitude of magnetic field intensity field intensity vector $(\bar{H})$?

a. $\frac{J_0}{r^2}(r^3 - a^3)$

b. $\frac{J_0}{r^2}(r^3 + a^3)$

c. $\frac{J_0(r^3 - a^3)}{3a^2 r}$

78. The potential (scalar) distribution is given as $v = 10y^4 + 20x^3$. If ε_0 is the permittivity of free space, what is the charge density ρ at the point (2,0) ?

a. $-200\,\varepsilon_0$
b. $-200/\varepsilon_0$
c. $200\,\varepsilon_0$
d. $-240\,\varepsilon_0$

79. The x-directed electric field E_x having sinusoidal item variation $e^{j\omega t}$ and space variation in z-direction satisfies the equation $\nabla^2 E_x + k^2 E_x = 0$ under source free condition in a lossless medium. What is the solution representing propagation in positive z-direction ?

a. $E_x = E_0 e^{-kz}$
b. $E_x = E_0 e^{+jkz}$
c. $E_x = E_0 e^{-jkz}$
d. $E_x = E_0 e^{+kz}$

80. What is the expression for capacitance of a solid infinitely conducting solid sphere of radius 'R' in free space?

a. $2\pi\,\varepsilon_0\,R$
b. $4\pi\,\varepsilon_0\,R$
c. $8\pi\,\varepsilon_0\,R$
d. $0.5\pi\,\varepsilon_0\,R$

81. Which one of the following concepts is used to find the expression of radiated $\bar{E}$ and $\bar{H}$ field due to a magnetic current element?

a. Concept of vector magnetic potential
b. Concept of scalar electric potential
c. Concept of scalar magnetic potential
d. Concept of vector electric potential

82. For an electromagnetic wave incident on a conducting medium, the depth of penetration

a. Is directly proportional to the attenuation constant
b. Is inversely proportional to the attenuation constant
c. Has a logarithmic relationship with the attenuation constant
d. Is independent of the attenuation constant

83. In a transmission line the reflection coefficient at the load end is given by $0.3e^{-j90°}$. What is the reflection coefficient at a distance of 0.1 wavelength towards source?

   a. $0.3e^{+j90°}$

   b. $0.3e^{+j102°}$

   c. $0.3e^{+j25°}$

   d. $0.3e^{-j6°}$

84. To couple a coaxial line to a parallel wire, it is best to use a:

   a. Balun

   b. Slotted line

   c. Directional coupler

   d. Quarter wave transformer

85. To avoid grating lobe at any arbitrary angle of scan using a uniformly spaced array to identical radiators with inter-element spacing 'd' and operating wavelength 'λ', which one of the following conditions should be satisfied?

   a. $d < 0.5 \lambda$

   b. $d < \lambda$

   c. $0.7 \leq d < 2\lambda$

   d. $0.5 \lambda < d < 2\lambda$

86. A uniform transmission line of characteristic impedance $100 \ \Omega$ and feeding a purely resistive load of $500 \ \Omega$ uses single stub matching. The stub is placed at a distance d from the load. The VSWR on the length d and on the stub itself will be

   a. 0 and 0, respectively

   b. 1 and 1, respectively

   c. 5 and 5, respectively

   d. 5 and ∞, respectively

87. A quarter wave transformer can be used for matching accurately :

   a. Inductive loads only

   b. Capacitive loads only

   c. Loads with any nature of reactance

   d. Purely resistive loads only

88. The dominant mode in a circular waveguide is a :

   a. T E M mode

   b. TM_{01} mode

   c. TE_{21} mode

   d. TE_{11} mode

89. The cut-off frequency of the dominant mode of a rectangular waveguide having aspect ratio more than 2 is 10 GHz. The inner broad wall dimension is given by :

   a. 3 cm

   b. 2 cm

   c. 1.5 cm

   d. 2.5 cm

90. A uniformly spaced linear array of identical radiators having uniform amplitude of excitation and linear phase variation with non zero gradient will produce:

   a. Pencil beam at broadside

   b. Fan beam

   c. Scanned cosecant beam

   d. Scanned pencil beam

91. For electronic scanning, the beam width with scan angle θ_0 away from broadside is proportional to :

   a. $\sec \theta_0$

   b. $\cos \theta_0$

   c. $\tan \theta_0$

   d. $\csc \theta_0$

92. In a waveguide, the evanescent modes are said to occur if :

   a. The propagation constant is real

   b. The propagation constant is imaginary

   c. Only the T E M waves propagate

   d. The signal has a constant frequency

93. A plane wave having x-directed electric field propagating in free space along the z-direction is incident on an infinite electrically conducting (perfect conductor) sheet at z = 0 plane. Which one of the following is correct?

   a. The sheet will absorb the wave

   b. There will be x-directed surface electric current on the sheet

   c. There will be y-directed surface electric current on the sheet

   d. There will be magnetic current in the sheet

94. Which one of the following instruments is most suitable to study the behaviour of a damped transient around 10kHz?
    a. Double beam CRO
    b. Recorder
    c. Storage Oscilloscope
    d. Plotter

95. Which one of the following is the most stable frequency primary atomic standard for frequency?
    a. Caesium beam standard
    b. Hydrogen maser standard
    c. Rubidium vapour standard
    d. Quartz crystal standard

96. Which one of the following pairs is not correctly matched?
    a. The temperatures below which certain materials are antiferro-magnetic and above which they are paramagnetic : Neel temperature
    b. Eddy current losses may be minimised by : Laminating the magnetic material
    c. The temperature at which a conductor becomes a super-conductor : Onne's temperature
    d. The lowest noise is expected in the : Metal film resistors

97.

(A) CRO connection diagram   (B) a trapezoidal pattern on CRO screen

For measurement of modulation factor by a CRO, a trapezoidal pattern is obtained on the CRO screen, as shown in figure (B) given above. What is the value of the modulation factor 'M'?
    a. 0
    b. 0.5
    c. 0.75
    d. 1

98. Which one of the following types of landline telemetry method has the advantage of simplicity and is free from noise, leakage and supply voltage variations?
    a. Current type
    b. Voltage type
    c. Position type
    d. Impulse type

99. Which one of the following transducers requires power supply for its operation?
    a. Thermocouple
    b. Photovoltaic cell
    c. Piezoelectric crystal
    d. Thermistor

100. Variation of which of the following parameters is related to the level change in the measurement of liquid level using two parallel metal rods immersed in a liquid tank?
    a. Area of plates
    b. Distance between plates
    c. Dielectric medium
    d. Length of plates immersed in the liquid

101. A piezoelectric transducer is a voltage source of 10 V with an internal impedance of 10 MΩ. It is connected to a digital oscilloscope with an input impedance of 10 MΩ directly. What is the voltage measured by the oscilloscope?
    a. 20 V
    b. 10 V
    c. 5 V
    d. 2.5 V

102. How can the resolution of a wire-wound potentiometer be improved?
    a. By increasing the applied voltage
    b. By decreasing the applied voltage
    c. By reducing the diameter of the resistance wire
    d. By increasing the diameter of the resistance wire

103. Creep error is associated with which one of the following meters?
    a. Moving iron meter
    b. Energy meter
    c. Electrodynamic meter
    d. Wattmeter

104. The voltage across an impedance is measured by a voltmeter having input impedance comparable with the

impedance causing an error in the reading. What is this error called?

a. Random error

b. Gross error

c. Systematic error

d. Loading effect error

105. Voltages $V_y = 100 \sin 1000\, t$ and $V_x = 50 \sin 1000\, t$ are connected to Y and X terminals of a CRO, respectively.

What is the shape of figure seen on the CRO?

a. A circle

b. A straight line

c. An ellipse

d. A parabola

106. The current passing through a 10 Ω resistance is given by $i = 3 + 4\sqrt{2}\sin 314\, t$

This current is measured by a PMMC meter. What is the measured value?

a. 3 A

b. 4 A

c. 5 A

d. $4\sqrt{2}$ A

107. What is the process of utilizing one data link for transmission of a group of variables known as?

a. Encoding

b. Decoding

c. Demultiplexing

d. Multiplexing

108. Match List I (Transducer) with List II (Measured Quantity) and select the correct answer using the code given below the Lists :

List I

A. Hall Effect pick up

B. Piezoelectric pick up

C. Hot-wire anemometer

D. Rotameter

List II

1. Pressure

2. Velocity of a fluid

3. Flow rate

4. Current

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

109. Which one of the following in simple elemental forms is not a pressure sensor?

a. Cantilever beam

b. Bourden tube

c. Diaphragm

d. Bellows

110. Which one of the following statements is correct?

a. A piezoelectric pressure transducer can be used for measuring both static and dynamic pressures

b. A resistance strain gauge type pressure transducer cannot be used for dynamic pressure measurement

c. Vacuum levels lower than 1 micron can be measured with an ionisation gauge

d. Accuracy of a manometer is affected by the shape or size of the tubes

111. An inductive pick up is used to measure speed of a shaft on which 120 tooth-wheel is attached. The number of pulses produced per second is 3000. What is the RPM of the shaft?

a. 1500

b. 1800

c. 3000

d. 3600

112. Assertion (A) : A CRO is capable of measurements at high frequencies.

Reason (R) : It uses high gain amplifiers for its operation.

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) : Even if two different approaches are used to solve Laplace equation we will end up in the same solution.

Reason (R) : It is mainly because in the process of solution, parameters relating to

potentials and their spatial rates of change may assume different values.

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) : A microstrip line cannot support pure TEM mode of propagation.

Reason (R) : A microstrip line suffers from various forms of losses.

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) : If a network contains a diode, Thevenin's theorem cannot be applied.

Reason (R) : Thevenin's theorem is applicable to linear and bilateral networks only.

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) : The discrete time system described by $y[n] = 2x[n] + 4x[n-1]$ is unstable. (here $y[n]$ is the output and $x[n]$ the input)

Reason (R) : It has an impulse response with a finite number of non-zero samples.

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) : The two transistor model of representation of a p-n-p-n device is its complete representation to explain the operation of the device both during turn ON and turn OFF conditions.

Reason (R) : p-n-p-n device can be thought of as a combination of one p-n-p transistor and another n-p-n transistor from the construction point of view, and that both p-n-p and n-p-n transistors also exhibit switching properties.

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 graded base BJTs exhibit better high frequency response characteristic as compared to their uniform base counterparts.

Reason (R) : There exists a built-in electric field in the base region of the graded base BJT which is absent in case of uniform base counterparts.

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) : Quartz crystals can be used both for the generation of ultrasonic waves as well as for their detection.

Reason (R) : When ultrasonic waves fall on a quartz crystal, the crystal undergoes mechanical vibrations and hence ultrasonic waves can be detected.

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) : In diamond, carbon atoms are packed in a manner so as to give rise to a very low packing efficiency.

Reason (R) : Carbon atoms have low mass number, and hence a smaller radius. Small atoms cannot be packed closely.

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