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T.B.C. : B–DMHH–N–FUA **Test Booklet Series**

Serial No.

91869

TEST BOOKLET

A

ELECTRONICS AND TELECOMMUNICATION ENGINEERING

Paper—I

Time Allowed : Two Hours **Maximum Marks : 200**

INSTRUCTIONS

1. IMMEDIATELY AFTER THE COMMENCEMENT OF THE EXAMINATION, YOU SHOULD CHECK THAT THIS TEST BOOKLET *DOES NOT* HAVE ANY UNPRINTED OR TORN OR MISSING PAGES OR ITEMS, ETC. IF SO, GET IT REPLACED BY A COMPLETE TEST BOOKLET.
2. **Please note that it is the candidate's responsibility to encode and fill in the Roll Number and Test Booklet Series Code A, B, C or D carefully and without any omission or discrepancy at the appropriate places in the OMR Answer Sheet. Any omission/ discrepancy will render the Answer Sheet liable for rejection.**
3. You have to enter your Roll Number on the Test Booklet in the Box provided alongside. *DO NOT* write *anything else* on the Test Booklet.
4. This Test Booklet contains **120** items (questions). Each item comprises four responses (answers). You will select the response which you want to mark on the Answer Sheet. In case you feel that there is more than one correct response, mark the response which you consider the best. In any case, choose *ONLY ONE* response for each item.
5. You have to mark your responses *ONLY* on the separate Answer Sheet provided. See directions in the Answer Sheet.
6. All items carry equal marks.
7. Before you proceed to mark in the Answer Sheet the response to various items in the Test Booklet, you have to fill in some particulars in the Answer Sheet as per instructions sent to you with your Admission Certificate.
8. After you have completed filling in all your responses on the Answer Sheet and the examination has concluded, you should hand over to the Invigilator *only the Answer Sheet*. You are permitted to take away with you the Test Booklet.
9. Sheets for rough work are appended in the Test Booklet at the end.
10. **Penalty for wrong answers :**
    THERE WILL BE PENALTY FOR WRONG ANSWERS MARKED BY A CANDIDATE.
    (i) There are four alternatives for the answer to every question. For each question for which a wrong answer has been given by the candidate, **one-third** of the marks assigned to that question will be deducted as penalty.
    (ii) If a candidate gives more than one answer, it will be treated as **wrong answer** even if one of the given answers happens to be correct and there will be same penalty as above to that question.
    (iii) If a question is left blank, i.e., no answer is given by the candidate, there will be **no penalty** for that question.

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1. The atomic packing factor for face-centred cubic (FCC) crystal structure is

   (a) 0·63

   (b) 0·74

   (c) 7·4

   (d) 6·3

2. Drift velocity in a metal is

   (a) inversely proportional to the force on an electron due to applied electric field

   (b) directly proportional to the mass of an electron

   (c) proportional to the mobility of an electron

   (d) inversely proportional to the strength of the applied electric field

3. The three kinds of breakdowns possible in solid dielectrics are electrothermal, purely electrical and

   (a) electromechanical

   (b) purely thermal

   (c) electrochemical

   (d) spontaneous

4. For a particular material, the Hall coefficient is found to be zero. The material is

   (a) intrinsic semiconductor

   (b) extrinsic semiconductor

   (c) metal

   (d) insulator

5. A 12 V automobile light is rated at 30 W. The total charge that flows through the filament in one minute is

   (a) 30 C

   (b) 12 C

   (c) 150 C

   (d) 180 C

6. At very high temperature, an *n*-type semiconductor behaves like

   (a) a *p*-type semiconductor

   (b) an intrinsic semiconductor

   (c) a superconductor

   (d) an *n*-type semiconductor

7. The Fermi level in a p-type semiconductor lies close to

(a) top of the valence band

(b) bottom of the valence band

(c) top of the conduction band

(d) bottom of the conduction band

8. Covalent bond energy in germanium is about

(a) 7·4 eV

(b) 31 eV

(c) 3·4 eV

(d) 20·4 eV

9. The relationship between relative permeability (μ_r) and magnetic susceptibility (χ) of the medium is

(a) $\mu_r = 1 + \chi$

(b) $\mu_r = \frac{1}{1+\chi}$

(c) $\mu_r = 1 - \chi$

(d) $\mu_r = \frac{1}{\chi}$

10. Ferromagnetic property may be explained on the basis of

(a) Faraday's theory

(b) Curie-Weiss theory

(c) domain theory

(d) Einstein's theory

11. Soft iron is characterized by the saturation magnetization M_S, coercivity H_C and retentivity B_C. It is suitable for an electromagnet because

(a) M_S, H_C and B_C are small

(b) M_S is small, H_C and B_C are large

(c) M_S is large, H_C and B_C are small

(d) M_S, H_C and B_C are large

12. Diamagnetic susceptibility is very

(a) small and negative

(b) small and positive

(c) large and negative

(d) large and positive

13. Magnetostriction is the effect produced when change of magnetization in magnetic material results in

(a) change of permeability

(b) change in dimensions

(c) change of temperature

(d) change of magnetic field strength

14. Commonly used dielectric in electrolytic capacitors is

(a) magnesium oxide

(b) cadmium nitride

(c) aluminium oxide

(d) manganese oxide

15. How many 6 μF, 200 V capacitors are needed to make a capacitor of 18 μF, 600 V ?

(a) 18

(b) 9

(c) 3

(d) 27

16. A voltage of 2000 V exists across 1 cm insulating space between two parallel conducting plates. An electron of charge $1{\cdot}6\times10^{-19}$ coulomb is introduced into the space. The force on the electron is

(a) $18{\cdot}2\times10^{-26}$ N

(b) $3{\cdot}2\times10^{-14}$ N

(c) $1{\cdot}6\times10^{-19}$ N

(d) $4{\cdot}5\times10^{26}$ N

17. A capacitor of 100 μF stores 10 mJ of energy. What is the amount of charge (in coulomb) stored in it?

(a) $1{\cdot}414\times10^{-6}$

(b) $1{\cdot}414\times10^{-3}$

(c) $2{\cdot}303\times10^{-6}$

(d) $2{\cdot}303\times10^{-3}$

18. In degenerately doped *n*-type semiconductor, the Fermi level lies in conduction band when

(a) concentration of electrons in the conduction band exceeds the density of states in the valence band

(b) concentration of electrons in the valence band exceeds the density of states in the conduction band

(c) concentration of electrons in the conduction band exceeds the product of the density of states in the valence band and conduction band

(d) None of the above

19. The electrical conductivity and electron mobility for aluminium are $3{\cdot}8 \times 10^7$ (ohm-m)$^{-1}$ and 0·0012 m^2/V-s, respectively. What is the Hall voltage for an aluminium specimen that is 15 mm thick for a current of 25 A and a magnetic field of 0·6 tesla (imposed in a direction perpendicular to the current) for the given value of Hall coefficient, R_H as $-3{\cdot}16 \times 10^{-11}$ V-m/A-tesla?

(a) -316×10^{-8} V

(b) $-3{\cdot}16 \times 10^{-8}$ V

(c) 316×10^{-8} V

(d) $3{\cdot}16 \times 10^{-8}$ V

20. The purpose of connecting a Zener diode in a UJT circuit, used for triggering thyristors, is to

(a) expedite the generation of triggering pulses

(b) delay the generation of triggering pulses

(c) provide a constant voltage to UJT to prevent erratic firing

(d) provide a variable voltage to UJT as the source voltage changes

21. A bridge rectifier uses a 9 V a.c. input voltage. The diodes are ideal. What is the d.c. output voltage?

(a) 12·726 V

(b) −12·726 V

(c) 9 V

(d) 8·1 V

22. A half-wave rectifier is used to supply 50 V d.c. to a resistive load of 800 Ω. The diode has resistance of 25 Ω. What is the required a.c. voltage?

(a) 50π

(b) $51{\cdot}5\pi$

(c) $25{\cdot}7\pi$

(d) 25π

23. If an input signal ranges from 20μA–40 μA with an output signal ranging from 0·5 mA–1·5 mA, what is the $\beta_{a.c.}$?

(a) 0·05

(b) 20

(c) 50

(d) 500

24. The best device for improving the switching speeds of bipolar transistors is

(a) speed-up capacitor

(b) transistor with higher cut-off frequency

(c) clamping diode

(d) clamping diode with zero storage time

25. The early effect in bipolar junction transistor is caused by

(a) fast turn-off

(b) fast turn-on

(c) large emitter to base forward bias

(d) large collector to base reverse bias

26. The basic material for fabrication of an LED is

(a) gallium arsenide

(b) gallium arsenide phosphide

(c) indium antimonide

(d) indium antimonide phosphide

27. To get higher cut-off frequency in a BJT, base sheet resistance should be

(a) low

(b) high

(c) equal to cut-off frequency

(d) zero

28. A BJT operates as a switch

(a) in the active region of transfer characteristics

(b) with no signal condition

(c) under small signal conditions

(d) under large signal conditions

29. *n-p-n* transistors are preferred over *p-n-p* transistors because they have

(a) high mobility of holes

(b) high mobility of electrons

(c) low mobility of holes

(d) higher mobility of electrons than the mobility of holes in *p-n-p* transistors

30. What is the biasing condition of junctions in bipolar junction transistor to work as an amplifier?

(a) Reverse biased base to emitter junction and reverse biased base to collector junction

(b) Forward biased base to emitter junction and reverse biased base to collector junction

(c) Forward biased base to emitter junction and forward biased base to collector junction

(d) Reverse biased base to emitter junction and forward biased base to collector junction

31. In a JFET, operating above pinch-off voltage, the

(a) drain current increases steeply

(b) drain current remains practically constant

(c) drain current starts decreasing

(d) depletion region reduces

32. If $V_{CC} = 18\,V$, voltage divider resistances $R_1 = 4{\cdot}7\,k\Omega$ and $R_2 = 1500\,\Omega$, what is the base bias voltage?

(a) 8·70 V

(b) 4·35 V

(c) 2·90 V

(d) 0·70 V

33. An SCR has an anode supply of sine voltage 200 $V_{r.m.s.}$, 50 Hz applied through a 100 Ω resistor and fired at an angle of 60°. Assuming no voltage drop, the r.m.s. value of the output voltage is nearly

(a) 90 V

(b) 126 V

(c) 166 V

(d) 200 V

34. In a GTO, anode current begins to fall when gate current

(a) is negative peak at time $t = 0$

(b) is negative peak at time t = storage period

(c) just begins to become negative at $t = 0$

(d) just begins to become positive at $t = 0$

35. An SCR is turned off when its turn-off time is

(a) less than the circuit time constant

(b) greater than the circuit time constant

(c) less than the circuit turn-off time

(d) greater than the circuit turn-off time

36. A system is characterized by the input-output relation

$$y(t) = x(2t) + x(3t)$$

for all t, where $y(t)$ is the output and $x(t)$ is the input. It is

(a) linear and causal

(b) linear and non-causal

(c) non-linear and causal

(d) non-linear and non-causal

37. A discrete-time system has input $x[\cdot]$ and output $y[\cdot]$ satisfying

$$y[m] = \sum_{j=-\infty}^{m} x[j]$$

The system is

(a) linear and unstable

(b) linear and stable

(c) non-linear and stable

(d) non-linear and unstable

38. The Fourier transform of a rectangular pulse for a period

$$t = -\frac{T}{2} \quad \text{to} \quad t = \frac{T}{2}$$

is

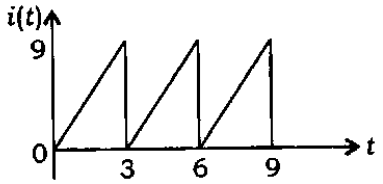
(a) a sinc function

(b) a sine function

(c) a cosine function

(d) a sine-squared function

39. The current waveform $i(t)$ in a pure resistor of 20 Ω is shown in the figure



The power dissipated in the resistor is

(a) 135 W

(b) 270 W

(c) 540 W

(d) 14·58 W

40. A *p*-type silicon sample has an intrinsic carrier concentration of $1{\cdot}5\times10^{10}/cm^3$ and a hole concentration of $2{\cdot}25\times10^{15}/cm^3$. Then the electron concentration is

(a) $1{\cdot}5\times10^{25}/cm^3$

(b) $10^5/cm^3$

(c) $10^{10}/cm^3$

(d) 0

41. A periodic function satisfies Dirichlet's conditions. This implies that the function

(a) is non-linear

(b) is not absolutely integrable

(c) guarantees that Fourier series representation of the function exists

(d) has infinite number of maxima and minima within a period

42. Consider Fourier representation of continuous and discrete-time systems. The complex exponentials (i.e., signals), which arise in such representation, have

(a) same properties always

(b) different properties always

(c) non-specific properties

(d) mostly same properties

43. If a dipole antenna has a radiation resistance of 73 Ω, the loss resistance of 7 Ω and the power gain is 16, then the directivity is

(a) 17·53 dB

(b) 24·7 dB

(c) 40 dB

(d) 14·6 dB

44. An LTI system is causal if and only if

(a) $h(t) = 0$ for $t < 0$

(b) $h(t)$ is finite for $0 < t < \infty$

(c) $h(t)$ is finite for $t < 0$

(d) $h(t)$ is non-zero for all t

45. Let $u[n]$ be the unit-step signal and

$$x[n] = \left(\frac{1}{2}\right)^n u[n] + \left(-\frac{1}{3}\right)^n u[n]$$

The region of convergence of z-transform of $x[n]$ is

(a) $|z| > \frac{1}{3}$

(b) $\frac{1}{3} < |z| < \frac{1}{2}$

(c) $|z| > \frac{1}{2}$

(d) $|z| < \frac{1}{2}$

46. If the z-transform of a sequence $x[n] = \{1, 1, -1, -1\}$ is $X(z)$, then the value of $X(\frac{1}{2})$ is

(a) 9

(b) 1·875

(c) −1·125

(d) 15

47. If the z-transform of a system is given by

$$H(z) = \frac{\alpha + z^{-1}}{1 + \alpha z^{-1}}$$

where α is real-valued, $|\alpha| < 1$, ROC: $|z| > |\alpha|$, then the system is

(a) a low-pass filter

(b) a band-pass filter

(c) an all-pass filter

(d) a high-pass filter

48. Consider a discrete random variable assuming finitely many values. The cumulative distribution function of such a random variable is

(a) non-increasing function

(b) non-decreasing function with finitely many discontinuities and assuming values less than one

(c) non-decreasing function without discontinuities

(d) non-decreasing function assuming values larger than one

49. A continuous random variable X has uncountably many values in the interval $[a, b]$. If C is a value in the interval $[a, b]$, then $P\{X = C\}$

(a) is zero

(b) is strictly non-zero

(c) depends on the limits $\{a, b\}$

(d) is less than one, but non-zero

50. In the case of a random variable dealing with non-deterministic signals

(a) it is a function from space of outcomes to the real/complex numbers

(b) it is a function with the probabilities of outcomes as random numbers

(c) the values assumed by signals are always deterministic

(d) sometimes the events associated with random variable are deterministic

51. The correlation function of a wide-sense stationary random process representing a non-deterministic signal is

(a) not a deterministic function

(b) deterministic, but not symmetric function

(c) sometimes non-deterministic function

(d) always deterministic and symmetric function

52. What is an advantage of MOS transistor structure in integrated circuits?

(a) Faster switching

(b) Less capacitance

(c) Higher component density and lower cost

(d) Lower resistance

53. An LTI system has a wide-sense stationary (WSS) input signal with zero mean. Its output is

(a) non-zero mean and non-WSS signal

(b) zero mean and WSS signal

(c) non-zero mean and WSS signal

(d) zero mean and non-WSS signal

54. Which of the following statements are correct in association with the superposition theorem?

1. It is applicable to networks having more than one source.
2. It is used to determine the current in a branch or voltage across branch.
3. It is applicable to direct current circuits only.
4. It is applicable to networks having linear and bilateral elements.

Select the correct answer using the code given below.

(a) 1, 2 and 3

(b) 1, 2 and 4

(c) 1, 3 and 4

(d) 2, 3 and 4

55. A network N consists of resistors, dependent and independent voltage and current sources. If the current in one particular resistance is I A, it will be doubled if the values of all the

(a) independent voltage sources are doubled

(b) independent current sources are doubled

(c) dependent and independent voltage and current sources are doubled

(d) independent voltage and current sources are doubled

56. The reactances of a 10 μF capacitor at $f = 0$ Hz (d.c.) and $f = 50$ Hz are respectively

(a) ∞ and 318·47 Ω

(b) 10·0 Ω and 318·47 Ω

(c) ∞ and 31·84 Ω

(d) 0·01 Ω and 31·84 Ω

57. Consider the following statements :

Any element is redundant if connected in

1. series with an ideal current source
2. parallel with an ideal current source
3. series with an ideal voltage source
4. parallel with an ideal voltage source

Which of the above statements are correct?

(a) 1 and 3

(b) 1 and 4

(c) 2 and 3

(d) 2 and 4

58. Inductive reactance X is a function of inductance L and frequency f. The value of X increases when

(a) both L and f increase

(b) L increases and f decreases

(c) both L and f decrease

(d) L decreases and f increases

59. An alternating voltage is given by the equation

$$v = 282{\cdot}84 \sin\left(377t + \frac{\pi}{6}\right)$$

What are the values of r.m.s. voltage, frequency and time period?

(a) 20 V, 60 Hz and 0·0167 s

(b) 200 V, 50 Hz and 0·02 s

(c) 200 V, 60 Hz and 0·0167 s

(d) 20 V, 50 Hz and 0·0167 s

60. If a capacitor is energized by a symmetrical square-wave current source, then the steady-state voltage across the capacitor will be

(a) a square wave

(b) a triangular wave

(c) a step function

(d) an impulse function

61. Consider an LTI system representing a passive electrical network. If the input is a sinusoidal signal, then the steady-state output of the network is

(a) sinusoidal with the same amplitude, frequency and phase

(b) sinusoidal with the same frequency, but possibly different amplitude and phase

(c) non-sinusoidal

(d) sinusoidal with a different frequency

62. A series R-L circuit ($R = 4\ \Omega$ and $L = 0{\cdot}01$ H) is excited by a voltage (in volt) $v(t) = 283 \sin(300t + 90°)$. The current in the circuit will be

(a) $40 \sin(300t + 53{\cdot}1°)$ A

(b) $40 \sin 53{\cdot}1°$ A

(c) $40\sqrt{2} \sin(300t + 53{\cdot}1°)$ A

(d) $40\sqrt{2} \sin 53{\cdot}1°$ A

63. An inductor L and 5 Ω and 10 Ω resistors are all connected in series across a voltage source $v(t) = 50\cos \omega t$ volt. If the power consumed by the 5 Ω resistor is 10 W, then the power factor of the circuit is

(a) 0·3

(b) 0·4

(c) 0·6

(d) 0·8

64. A graph in which at least one path (disregarding orientation) exists between any two nodes of the graph is a

(a) connected graph

(b) directed graph

(c) sub-graph

(d) fundamental graph

65. If Q_t and Q_l be the sub-matrices of Q_f (fundamental cut-set matrix) corresponding to twigs and links of a connected graph respectively, then

1. Q_t is an identity matrix
2. Q_l is a rectangular matrix
3. Q_f is of rank $(n-1)$

Which of the above are correct?

(a) 1 and 2 only

(b) 1 and 3 only

(c) 2 and 3 only

(d) 1, 2 and 3

66. Tellegen's theorem (as applicable to any lumped d.c. network, regardless of the elements being linear or non-linear, time-varying or time-invariant) implies that

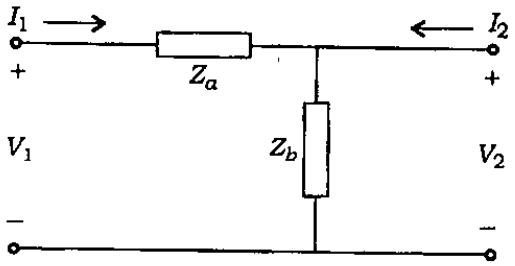
(a) sum of the voltage drops across each network element is equal to the total voltage applied to the network

(b) sum of the powers taken by all elements, in the network, within the constraints imposed by KCL and KVL is zero

(c) sum of the currents meeting at any node is not the same as the current in that mesh

(d) it is applicable to a branch which is not coupled to other branches of the network

67. For the two-port network shown in the figure



the transmission parameter C is

(a) Z_a

(b) $1+\frac{Z_a}{Z_b}$

(c) Z_b

(d) $\frac{1}{Z_b}$

68. Two identical two-port networks having transmission matrix

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

are cascaded. What will be the resultant transmission matrix of the cascade?

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

(b) $\begin{bmatrix} 2A & 2B \\ 2C & 2D \end{bmatrix}$

(c) $\begin{bmatrix} A^2 + BC & AB + BD \\ AC + CD & BC + D^2 \end{bmatrix}$

(d) $\begin{bmatrix} A^2 & B^2 \\ C^2 & D^2 \end{bmatrix}$

69. The unit impulse response of a system is $-4e^{-t} + 6e^{-2t}$. The step response of the same system for $t \geq 0$ is $Ae^{-t} + Be^{-2t} + C$, where A, B and C are respectively

(a) –4, –3 and +1

(b) +4, –3 and –1

(c) –4, –3 and –1

(d) +4, –3 and +1

70. The network function, $H(s)$ is equal to

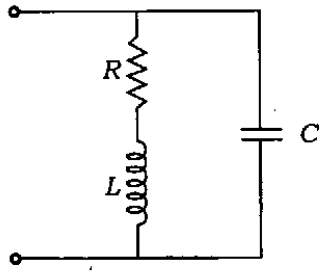
(a) $\frac{y(s)}{x(s)}$

(b) $\frac{x(s)}{y(s)}$

(c) $x(s)\, y(s)$

(d) $\frac{1}{x(s)\, y(s)}$

71. The driving-point impedance of the network shown in the figure has a zero at –4 and poles at $-2 \pm j5$.



If $Z(0) = 1$, the values of R, L and C are respectively

(a) $\frac{1}{4}$, 1 and $\frac{4}{29}$

(b) 1, $\frac{1}{4}$ and $\frac{4}{29}$

(c) $\frac{4}{29}$, $\frac{1}{4}$ and 1

(d) 1, 2 and $\frac{2}{29}$

72. If $Z(s) = \frac{(s+4)(s+9)}{(s+1)(s+16)}$ is a driving-point impedance, it represents an

(a) *R-C* impedance

(b) *R-L* impedance

(c) *L-C* impedance

(d) *R-L-C* impedance

73. The numerical value of the ratio of electric field intensity E and magnetic field intensity H is

(a) 350 Ω *(b)* 377 Ω

(c) 37·7 Ω *(d)* 35 Ω

74. Consider a long line charge of λ coulomb/metre perpendicular to the plane of a paper. The electrical field lines and equi-potential surfaces are respectively

(a) radial, cylindrical concentric with line charge

(b) cylindrical concentric with line charge, radial

(c) radial, radial but opposite in direction

(d) concentric with line charge, parallel to line charge

75. Which of the following statements about electric field lines associated with electric charges is false?

(a) Electric field lines can be either straight or curved

(b) Electric field lines form closed loops

(c) Electric field lines begin on positive charges and end on negative charges

(d) Electric field lines do not intersect

76. Which of the following represents Maxwell's divergence equation for static electric field?

(a) $\nabla \cdot B = 0$

(b) $\nabla \times H = 0$

(c) $\nabla \cdot B = \mu$

(d) $\nabla \times H = \mu$

77. A current of 5 A passes along the axis of a cylinder of 5 cm radius. The flux density at the surface of the cylinder is

(a) 2 μT

(b) 20 μT

(c) 200 μT

(d) 2000 μT

78. Maxwell's major contribution to EM theory was to assert

(a) that an electric field varying with time in free space gives rise to a current

(b) that a magnetic field varying with time gives rise to an electric field

(c) that a magnetic field varying with space gives rise to an electric field

(d) that energy density due to an electric field is $\frac{1}{2}\varepsilon E^2$

79. Consider the following statements regarding Maxwell's equation in differential form :

1. For free space

$$\nabla \times H = (\sigma + j\omega\varepsilon) E$$

2. For free space, $\nabla \cdot D = \rho$
3. For steady current, $\nabla \times H = J$
4. For static electric field, $\nabla \cdot D = \rho$

Which of the above statements are correct?

(a) 1 and 2

(b) 2 and 3

(c) 3 and 4

(d) 4 and 1

80. The equation which states the non-existence of isolated magnetic pole is

(a) $\nabla \cdot D = \rho$

(b) $\nabla \cdot B = 0$

(c) $\nabla \cdot J = -\frac{\partial \rho}{\partial t}$

(d) $\nabla \times H = J$

81. The electric field in an electromagnetic wave (in vacuum) is described by

$$E = E_{max} \sin(Kx - \omega t)$$

where

$E_{max} = 100$ N/C and $K = 1 \times 10^7$ m^{-1}

Speed of light is 3×10^8 m/s. What is the amplitude of the corresponding magnetic wave?

(a) $4{\cdot}57 \times 10^{-7}$ T

(b) $2{\cdot}99 \times 10^{-7}$ T

(c) $3{\cdot}33 \times 10^{-7}$ T

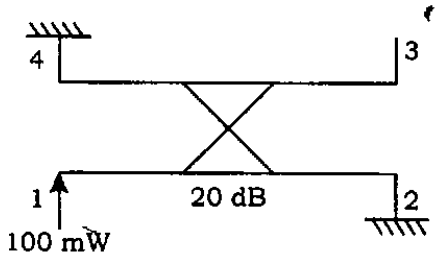
(d) $2{\cdot}99 \times 10^{7}$ T

82. For transverse electric waves between parallel plates, the lowest value of m, without making all the field components zero, is equal to

(a) 3 *(b)* 2

(c) 1 *(d)* 0

83. A 20 dB directional coupler is shown in the figure



The power output at port 3 will be

(a) 10 mW

(b) 1 mW

(c) 5 mW

(d) 2 mW

84. A loss-less transmission line of length l is open-circuited and has characteristic impedance Z_0. The input impedance is

(a) $+j Z_0 \tan\beta l$

(b) $-j Z_0 \tan\beta l$

(c) $-j Z_0 \cot\beta l$

(d) $+j Z_0 \cot\beta l$

85. Conditions for a transmission line to be of low loss are

(a) $R >> \omega L$, $G >> \omega C$

(b) $R << \omega L$, $G >> \omega C$

(c) $R << \omega L$, $G << \omega C$

(d) $R >> \omega L$, $G << \omega C$

86. In a waveguide, attenuation near the cut-off frequency is

(a) low

(b) high

(c) very high

(d) zero

87. The phase velocity of waves propagating in a hollow metal waveguide is

(a) equal to the group velocity

(b) equal to the velocity of light in free space

(c) less than the velocity of light in free space

(d) greater than the velocity of light in free space

88. Compensation theorem applicable to antennas is also called as

(a) Millman's theorem

(b) superposition theorem

(c) substitution theorem

(d) power transfer theorem

89. An isotropic radiator is one which radiates energy

(a) in a well-defined direction

(b) uniformly in all directions

(c) inside a hollow space

(d) uniformly in horizontal plane

90. The effective length of an antenna is a measure of

(a) length of the antenna neglecting fringe effects

(b) effectiveness of the antenna as a radiator/collector of electro-magnetic energy

(c) power consumed by the antenna

(d) range of the antenna

91. For a dipole antenna

(a) the radiation intensity is maximum along the normal to the dipole axis

(b) the current distribution along its length is uniform irrespective of the length

(c) the effective length equals its physical length

(d) the input impedance is independent of the location of the feed-point

92. An ideal voltage source and an ideal voltmeter have internal impedances respectively

(a) zero, zero

(b) zero, infinite

(c) infinite, zero

(d) infinite, infinite

93. The current in a circuit is measured as 235 μA and the accuracy of measurement is ±0·5 %. This current passes through a resistor 35 kΩ ± 0·2 %. The voltage is estimated to be 8·23 V. The error in the estimation would be

(a) ± 0·06 V

(b) ± 0·04 V

(c) ± 0·016 V

(d) ± 0·1 V

94. The full-scale deflecting torque of a 20 A moving-iron ammeter is 6×10^{-5} N-m. What is the rate of change of self-inductance with respect to the deflection of the pointer of the ammeter at full scale?

(a) 0·5 μH/rad

(b) 0·2 μH/rad

(c) 1·3 μH/rad

(d) 0·3 μH/rad

95. The expected value of the voltage across a resistor is 80 V. However, the voltmeter reads 79 V. The absolute error in the measurement is

(a) 0·875 V

(b) 0·125 V

(c) 1·00 V

(d) 1·125 V

96. A current of 2 ± 0·5% A passes through a resistor of 100 ± 0·2% Ω. The limiting error in the computation of power will be

(a) 0·7%

(b) 0·9%

(c) 1·2%

(d) 1·5%

97. A voltmeter reads 40 V on its 100 V range and an ammeter reads 75 mA on its 150 mA range in a circuit. Both the instruments are guaranteed ±2% accuracy on FSD. The limiting error on the measured power is

(a) 4%

(b) 5%

(c) 9%

(d) 12%

98. A voltmeter, having a guaranteed accuracy of 1%, reads 9 V on a 0 V to 150 V range full-scale reading. The percentage limiting error is

(a) 0·167%

(b) 1·67%

(c) 16·7%

(d) 0·0167%

99. A moving-coil instrument has a resistance of 10 Ω and gives a full-scale deflection when carrying a current of 50 mA. What external resistance should be connected so that the instrument can be used to measure current up to 50 A?

(a) 20 Ω in parallel

(b) 100 Ω in series

(c) 0·010 Ω in parallel

(d) 18·7 Ω in series

100. A current of 2·0 A passes through a cell of e.m.f. 1·5 V having internal resistance of 0·15 Ω. The potential difference across the terminals of the cell is

(a) 1·35 V

(b) 1·50 V

(c) 1·00 V

(d) 1·20 V

101. A moving-coil meter has a resistance of 3 Ω and gives full-scale deflection with 30 mA. What external resistance should be added in series so that it can measure voltages up to 300 V?

(a) 10 Ω

(b) 9997 Ω

(c) 0·19 Ω

(d) 0·01 Ω

102. Consider the following system function of a discrete-time LTI system :

$$H(z) = \frac{z^{-1} - a^*}{1 - az^{-1}}$$

where a^* is the complex conjugate of a. The frequency response of such a system is

(a) aperiodic; depends on frequency ω

(b) aperiodic; does not depend on frequency ω

(c) periodic; depends on frequency ω

(d) periodic; does not depend on frequency ω

103. Absolute encoders are normally used for

(a) one revolution

(b) continuous speed in clockwise direction

(c) continuous speed in counter-clockwise direction

(d) counting least significant bits

104. Consider the following statements :

Piezoelectric transducer has

1. a very good HF response
2. typical output voltage of the order of 1 mV to 30 mV per unit of acceleration
3. no requirement of external power and is self-generating
4. no response for static conditions

Which of the above statements are correct?

(a) 1, 2 and 3 only

(b) 1, 2 and 4 only

(c) 3 and 4 only

(d) 1, 2, 3 and 4

105. An inductive pick-up used to measure the speed of a shaft has 120-tooth wheel. If the number of pulses produced in a second is 3000, the r.p.m. of the shaft is

(a) 1200

(b) 1500

(c) 1800

(d) 3600

106. A piezoelectric crystal having a thickness of 2 mm and a voltage sensitivity of 0·02 V-m/N is subjected to a pressure of 20×10^3 Pa. What is the output voltage?

(a) 0·775 V

(b) 0·80 V

(c) $0{\cdot}002 \times 10^{-6}$ V

(d) $0{\cdot}2 \times 10^{-6}$ V

107. A resistance strain gauge with gauge factor of 3 is cemented to a steel member subjected to a strain of 2×10^{-6}. If the original resistance is 100 Ω, what is the change in resistance?

(a) 600 μΩ

(b) 600 mΩ

(c) 300 μΩ

(d) 200 μΩ

108. The dynamic characteristics of capacitive transducers are similar to those of

(a) low-pass filter

(b) high-pass filter

(c) notch filter

(d) band-stop filter

109. Cold junction in a thermocouple is

(a) the reference junction maintained at a known constant temperature

(b) the junction maintained at a very low temperature

(c) the junction at which the temperature is sensed

(d) None of the above

110. The output voltage of a linear variable differential transformer is 1·5 V at maximum displacement. At a load of 0·5 MΩ, the deviation from linearity is maximum and it is ± 0·003 V from a straight line through origin. What is the linearity at the given load?

(a) ± 1·5%

(b) ± 0·2%

(c) ± 2·2%

(d) ± 15%

Directions :

Each of the following **ten (10)** items consists of two statements, one labelled as 'Statement (I)' and the other as 'Statement (II)'. Examine these two statements carefully and select the answers to these items using the code given below.

Code :

(a) Both Statement (I) and Statement (II) are individually true and Statement (II) is the correct explanation of Statement (I)

(b) Both Statement (I) and Statement (II) are individually true but Statement (II) is ***not*** the correct explanation of Statement (I)

(c) Statement (I) is true but Statement (II) is false

(d) Statement (I) is false but Statement (II) is true

111. Statement (I) :

Hard magnetic materials are used for making permanent magnets.

Statement (II) :

Hard magnetic materials have relatively small and narrow hysteresis loop.

112. Statement (I) :

With a small additional energy, usually thermal, the valence electrons in germanium can become free electrons.

Statement (II) :

The valence electrons in germanium are in the fourth orbit and are at high energy level.

113. Statement (I) :

An FET is a current-controlled device.

Statement (II) :

Operation of an FET depends only on majority carriers.

114. Statement (I) :

Thermal runaway is not possible in an FET.

Statement (II) :

As the temperature of FET increases, the mobility of carriers decreases.

115. Statement (I) :

In an enhancement type MOSFET (with *n*-type source and drain regions), only positive voltage can be applied to the gate with respect to the substrate (*p*-type).

Statement (II) :

Only with a positive voltage to the gate, an 'inversion layer' is formed and conduction can take place.

116. Statement (I) :

Under steady-state condition, a pure capacitor behaves as an open circuit for direct voltage.

Statement (II) :

The current through a capacitor is proportional to the rate of change of voltage.

117. Statement (I) :

The standard definition of stability precludes $\sin \omega_0 t$ term in impulse response.

Statement (II) :

$\sin \omega_0 t$ is a periodic function.

118. Statement (I) :

Helical antenna has the largest bandwidth, high directivity and circular polarization.

Statement (II) :

Log-periodic antenna has a broad bandwidth.

119. Statement (I) :

Current-limiting resistor is used in series with the light-emitting diode (LED) to limit current and light output.

Statement (II) :

The light output of a light-emitting diode (LED) is approximately proportional to the current passing through it.

120. Statement (I) :

An analog system has at its output stage a PMMC indicating instrument, while a digital meter output stage has an LCD/LED display device.

Statement (II) :

Since the analog system is continuous in time, display device can respond to it if the signal frequency is low, while digital system being a discrete one, it does not require change and can be latched at the value of measurement.

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