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T.B.C. : B-DMHH-N-FUA

Test Booklet Series

Serial No.

91869

A

**TEST BOOKLET
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.

DO NOT OPEN THIS TEST BOOKLET UNTIL YOU ARE ASKED TO DO SO

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 $6\ \mu\text{F}$, $200\ \text{V}$ capacitors are needed to make a capacitor of $18\ \mu\text{F}$, $600\ \text{V}$?

- (a) 18
- (b) 9
- (c) 3
- (d) 27

16. A voltage of $2000\ \text{V}$ exists across $1\ \text{cm}$ insulating space between two parallel conducting plates. An electron of charge 1.6×10^{-19} coulomb is introduced into the space. The force on the electron is

- (a) $18.2 \times 10^{-26}\ \text{N}$
- (b) $3.2 \times 10^{-14}\ \text{N}$
- (c) $1.6 \times 10^{-19}\ \text{N}$
- (d) $4.5 \times 10^{26}\ \text{N}$

17. A capacitor of $100\ \mu\text{F}$ stores $10\ \text{mJ}$ of energy. What is the amount of charge (in coulomb) stored in it?

- (a) 1.414×10^{-6}
- (b) 1.414×10^{-3}
- (c) 2.303×10^{-6}
- (d) 2.303×10^{-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 $3.8 \times 10^7 \text{ (ohm-m)}^{-1}$ and $0.0012 \text{ m}^2/\text{V-s}$, 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 $-3.16 \times 10^{-11} \text{ V-m/A-tesla}$?

- (a) $-316 \times 10^{-8} \text{ V}$
- (b) $-3.16 \times 10^{-8} \text{ V}$
- (c) $316 \times 10^{-8} \text{ V}$
- (d) $3.16 \times 10^{-8} \text{ V}$

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 800Ω . The diode has resistance of 25Ω . What is the required a.c. voltage?

- (a) 50π
- (b) 51.5π
- (c) 25.7π
- (d) 25π

23. If an input signal ranges from $20 \mu\text{A}$ – $40 \mu\text{A}$ 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 $V_{CC} = 18\text{ V}$, voltage divider resistances $R_1 = 4.7\text{ k}\Omega$ 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 $200\text{ V}_{\text{r.m.s.}}$, 50 Hz applied through a $100\ \Omega$ 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 $t = \text{storage period}$
- (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

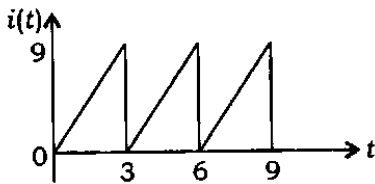
38. The Fourier transform of a rectangular pulse for a period

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

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 $20\ \Omega$ 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 $1.5 \times 10^{10}/\text{cm}^3$ and a hole concentration of $2.25 \times 10^{15}/\text{cm}^3$. Then the electron concentration is

- (a) $1.5 \times 10^{25}/\text{cm}^3$
 (b) $10^5/\text{cm}^3$
 (c) $10^{10}/\text{cm}^3$
 (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 $73\ \Omega$, the loss resistance of $7\ \Omega$ 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 $X\left(\frac{1}{2}\right)$ 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 $10 \mu\text{F}$ capacitor at $f = 0$ Hz (d.c.) and $f = 50$ Hz are respectively

- (a) ∞ and 318.47Ω
- (b) 10.0Ω and 318.47Ω
- (c) ∞ and 31.84Ω
- (d) 0.01Ω and 31.84Ω

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

$$v = 282.84 \sin\left(377t + \frac{\pi}{6}\right)$$

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 $L = 0.01$ H) is excited by a voltage (in volt) $v(t) = 283 \sin(300t + 90^\circ)$. The current in the circuit will be

- (a) $40 \sin(300t + 53.1^\circ)$ A
- (b) $40 \sin 53.1^\circ$ A
- (c) $40\sqrt{2} \sin(300t + 53.1^\circ)$ A
- (d) $40\sqrt{2} \sin 53.1^\circ$ A

63. An inductor L and $5\ \Omega$ and $10\ \Omega$ resistors are all connected in series across a voltage source $v(t) = 50\cos\ \omega t$ volt. If the power consumed by the $5\ \Omega$ resistor is $10\ \text{W}$, 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 $(n - 1)$

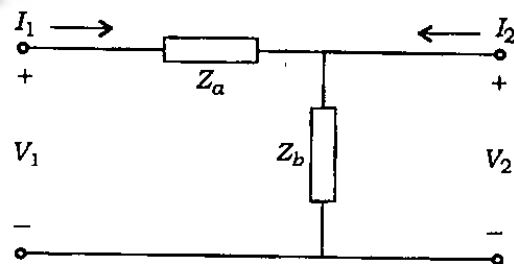
Which of the above are correct?

- (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

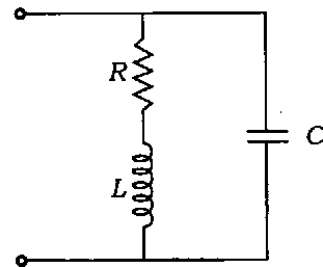
(a) $\frac{y(s)}{x(s)}$

(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 equipotential 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 $\frac{1}{2}\epsilon E^2$

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

1. For free space

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

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

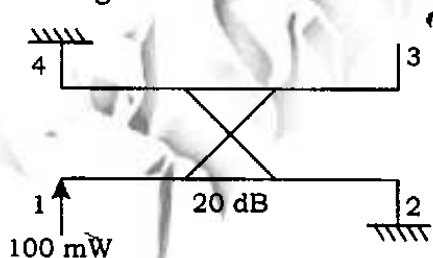
$$E_{\max} = 100 \text{ N/C and } K = 1 \times 10^7 \text{ m}^{-1}$$

Speed of light is $3 \times 10^8 \text{ m/s}$.
What is the amplitude of the corresponding magnetic wave?

- (a) $4.57 \times 10^{-7} \text{ T}$
 (b) $2.99 \times 10^{-7} \text{ T}$
 (c) $3.33 \times 10^{-7} \text{ T}$
 (d) $2.99 \times 10^7 \text{ T}$
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) $R \gg \omega L, G \gg \omega C$
 (b) $R \ll \omega L, G \gg \omega C$
 (c) $R \ll \omega L, G \ll \omega C$
 (d) $R \gg \omega L, G \ll \omega C$

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 electromagnetic 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 $235\mu\text{A}$ and the accuracy of measurement is $\pm 0.5\%$. This current passes through a resistor $35\text{k}\Omega \pm 0.2\%$. The voltage is estimated to be 8.23 V . The error in the estimation would be

- (a) $\pm 0.06\text{ V}$
- (b) $\pm 0.04\text{ V}$
- (c) $\pm 0.016\text{ V}$
- (d) $\pm 0.1\text{ V}$

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

- (a) $0.5\ \mu\text{H}/\text{rad}$
- (b) $0.2\ \mu\text{H}/\text{rad}$
- (c) $1.3\ \mu\text{H}/\text{rad}$
- (d) $0.3\ \mu\text{H}/\text{rad}$

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 $2 \pm 0.5\% \text{ A}$ passes through a resistor of $100 \pm 0.2\% \Omega$. 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 $\pm 2\%$ 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) 0.002×10^{-6} V
- (d) 0.2×10^{-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 $\mu\Omega$
- (b) 600 m Ω
- (c) 300 $\mu\Omega$
- (d) 200 $\mu\Omega$

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 M Ω , 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) $\pm 1.5\%$
- (b) $\pm 0.2\%$
- (c) $\pm 2.2\%$
- (d) $\pm 15\%$

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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TEST BOOKLET


ELECTRONICS & TELECOMMUNICATION ENGINEERING

Paper II

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 all 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 (0.33)** 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 a **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 current gain of a bipolar transistor drops at high frequency because of
 - (a) Transistor capacitances
 - (b) High current effects in the base
 - (c) Parasitic inductive elements
 - (d) The early effect

2. The maximum depletion layer width in Silicon is
 - (a) $0.143 \mu\text{m}$
 - (b) $0.857 \mu\text{m}$
 - (c) $1 \mu\text{m}$
 - (d) $1.143 \mu\text{m}$

3. A bipolar transistor is operating in the active region with a collector current of 1 mA. The β of the transistor is 100 and the thermal voltage (V_T) is 25 mV. The trans-conductance (g_m) and the input resistance (r_π) of the transistor in the common emitter configuration are, respectively
 - (a) 25 mA/V and 15.625 k Ω
 - (b) 40 mA/V and 4.0 k Ω
 - (c) 25 mA/V and 2.5 k Ω
 - (d) 40 mA/V and 2.5 k Ω

4. For a transformer, the load connected to the secondary has an impedance of 8 Ω . Its reflected impedance on primary is observed to be 648 Ω . The turns ratio of this transformer is
 - (a) 6 : 1
 - (b) 10 : 1
 - (c) 9 : 1
 - (d) 8 : 1

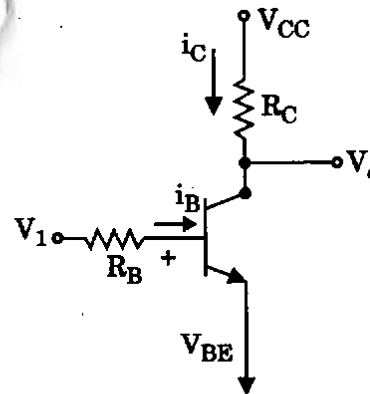
5. An amplifier with mid band gain $|A| = 500$ has negative feedback $|b| = \frac{1}{100}$. If upper cut-off without feedback were at 60 kHz, then with feedback it would become
 - (a) 10 kHz
 - (b) 360 kHz
 - (c) 12 kHz
 - (d) 300 kHz

6. A tuned amplifier has a maximum output at 4 MHz with a quality factor 50. The bandwidth and half power frequencies are, respectively
 - (a) 80 kHz and 4.04 MHz; 3.96 MHz
 - (b) 80 kHz and 4.08 MHz; 3.92 MHz
 - (c) 40 kHz and 4.04 MHz; 3.96 MHz
 - (d) 40 kHz and 4.08 MHz; 3.92 MHz

7. A power amplifier with a gain of $100 \angle 0^\circ$ has an output of 12 V at 1.5 kHz along with a second harmonic content of 25 percent. A negative feedback is to be provided to reduce the harmonic content of the output to 2.5 percent. What should be the gain of the feedback path and the level of signal input to the overall system, respectively ?
 - (a) 0.9 and 0.12 V
 - (b) 0.9 and 12 V
 - (c) 0.09 and 1.2 V
 - (d) 9 and 0.12 V

8. The right side of a state equation represents
 - (a) Next state of flip-flop
 - (b) Present state of flip-flop
 - (c) Present state condition that makes the next state equal to 1
 - (d) None of the above

9. A full wave rectifier with a centre-tapped transformer supplies dc current of 100 mA to a load resistance of 20 Ω . The secondary resistance of transformer is 1 Ω . Each diode has a forward resistance of 0.5 Ω . What are rms values of signal voltage across each half of the secondary as well as dc power supplied to the load ?
- 2.39 V and 0.2 Watt
 - 23.9 V and 2 Watts
 - 0.239 V and 20 Watts
 - 2.39 V and 2 Watts
10. An Op-Amp has the following open loop parameters $Z_{in} = 300 \text{ k}\Omega$, $Z_{out} = 100 \Omega$, $A = 50,000$. The low frequency system input and output impedances, when closed loop gain is set to 100, are
- 0.6 Ω and 50 k Ω
 - 150 M Ω and 0.2 Ω
 - Same as in open loop
 - None of the above
11. The differential gain of Op-Amp is 4000 and value of CMRR is 150. Its output voltage, when the two input voltages are 200 μV and 160 μV respectively, will be
- 16 V
 - 164.8 mV
 - 64 mV
 - 76 mV
12. An amplifier using an Op-Amp with a slew-rate $SR = 1 \text{ V}/\mu \text{ sec}$ has a gain of 40 dB. If this amplifier has to faithfully amplify sinusoidal signals from 10 to 20 kHz, without introducing any slew-rate induced distortion, then the input signal level must *not* exceed
- 795 mV
 - 395 mV
 - 79.5 mV
 - 39.5 mV
13. Which oscillator is characterized by a split capacitor in its tank circuit ?
- RC phase shift oscillator
 - Colpitts oscillator
 - Wien bridge oscillator
 - None of the above
14. A 1 μs pulse can be converted into a 1 ms pulse by using
- A monostable multivibrator
 - An astable multivibrator
 - A bistable multivibrator
 - A J-K flip-flop
15. The transistor switch as shown in figure has $\beta = 120$, $V_{CE(\text{Sat})} = 0.2 \text{ V}$, $R_C = 1.2 \text{ k}\Omega$, and $V_{CC} = 5 \text{ V}$.



The output voltage when transistor switch is closed and the minimum base current needed to close the switch are, respectively

- 0.2 V and 3.33 μA
- 2 V and 3.33 μA
- 0.2 V and 33.3 μA
- 2 V and 33.3 μA

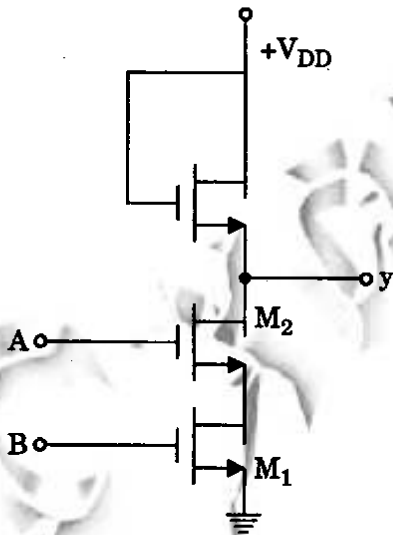
16. A plant is controlled by a proportional controller. If a time delay element is introduced in the loop, its

- (a) Phase margin remains the same
- (b) Phase margin increases
- (c) Phase margin decreases
- (d) Gain margin increases

17. When damping ratio is equal to zero, the damping frequency of a system is

- (a) Equal to natural frequency
- (b) Zero
- (c) More than natural frequency
- (d) Less than natural frequency

18. The circuit shown in figure is

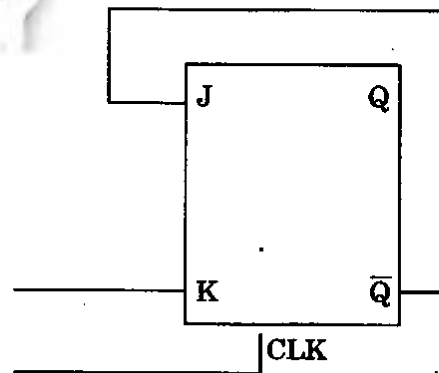


- (a) OR gate
- (b) NOR gate
- (c) NAND gate
- (d) AND gate

19. A binary-to-BCD encoder has four inputs D_0 , C_0 , B_0 and A_0 and five outputs D, C, B, A and VALID. The outputs D, C, B and A give the proper BCD value of the input and the VALID output is 1 if the input combination is a valid decimal code. If the input combination is an invalid decimal code, the VALID output becomes 0 and all of the D, C, B and A outputs show 0 values. If only NOT gates and 2-input OR and AND gates are available, the minimum number of gates required to implement the above circuit is

- (a) 10
- (b) 9
- (c) 8
- (d) 7

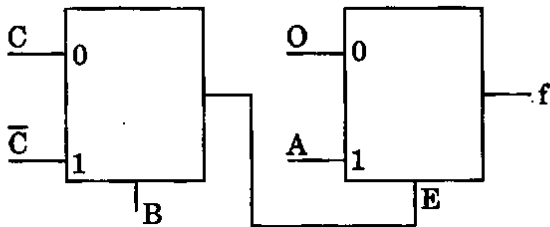
20. In the J-K flip-flop we have $J = \bar{Q}$ and $K = 1$ as shown in the figure.



Assuming the flip-flop was initially cleared and then clocked for 6 pulses, the sequence at the Q output will be

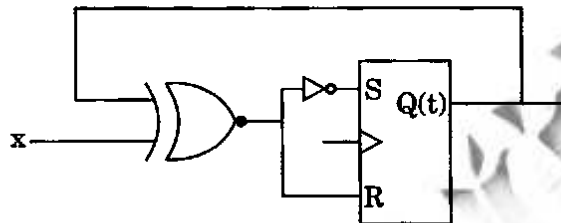
- (a) 010000
- (b) 011001
- (c) 010010
- (d) 010101

21. The Boolean function 'f' implemented as shown in the figure using two input multiplexers is



- (a) $\overline{A}BC + A\overline{B}\overline{C}$
 (b) $ABC + \overline{A}\overline{B}\overline{C}$
 (c) $\overline{A}BC + ABC$
 (d) $\overline{A}\overline{B}C + \overline{A}BC$

22. Consider the circuit shown in the figure. The expression for the next state $Q(t+1)$ is



- (a) $x Q(t)$
 (b) $x \oplus Q(t)$
 (c) $x \overline{Q}(t)$
 (d) $x \odot Q(t)$

23. The outputs Q and \overline{Q} of master slave S - R flip-flop are connected to its R and S inputs respectively. The output Q when clock pulses are applied will be
- (a) Permanently 0
 (b) Permanently 1
 (c) Fixed 0 or 1
 (d) Complementing with every clock pulse

24. Consider the following statements :

1. A flip-flop is used to store 1 bit of information.
2. Race around condition occurs in a J-K flip-flop when both of its inputs are 1.
3. Master slave configuration is used in flip-flops to store 2 bits of information.
4. A transparent latch consists of D-type flip-flops.

Which of the above statements are correct ?

- (a) 1, 2 and 3
 (b) 1, 3 and 4
 (c) 1, 2 and 4
 (d) 2, 3 and 4

25. A circuit consists of two synchronously clocked J-K flip-flops connected as follows :

$J_0 = K_0 = \overline{Q}_1$, $J_1 = Q_0$, $K_1 = \overline{Q}_0$. The circuit acts as a

- (a) Counter of mod 2
 (b) Counter of mod 3
 (c) Shift-right register
 (d) Shift-left register

26. A semiconductor RAM has a 12-bit address register and an 8-bit data register. The total number of bits in the memory is

- (a) 256 bits
 (b) 4,096 bits
 (c) 32,768 bits
 (d) 10,48,576 bits

27. When electromagnetic waves are propagated in a waveguide

- (a) They travel along the walls of the waveguide
 (b) They travel through the dielectric without touching the walls
 (c) They are reflected from the walls but do not travel along the walls
 (d) None of the above

28. A dual slope analog to digital converter uses N-bit counter. When the input signal V_a is being integrated, the counter is allowed to count up to the value
- Equal to $2^N - 2$
 - Equal to $2^N - 1$
 - Proportional to V_a
 - Inversely proportional to V_a
29. For a 5-bit ladder D/A converter which has digital input of 10101, the analog output value is (Assume $0 = 0\text{ V}$ and $1 = +10\text{ V}$, $R_f = 3R$)
- -3.32 V
 - -4.32 V
 - -6.56 V
 - -7.48 V
30. A 5-bit D/A converter has a current output. If an output current $I_{\text{out}} = 10\text{ mA}$ is produced for a digital input of 10100, the value of I_{out} for a digital input of 11101 will be
- 12.5 mA
 - 13.5 mA
 - 15.5 mA
 - 14.5 mA
31. What is the total memory range and memory map, if for a 16-bit address bus; $A_{15} = 1$, $A_{14} = 0$ and $A_{13} - A_{11}$ are connected to a 3-8 decoder input lines? A_{15} and A_{14} are connected to enable the decoder.
- 16 K, 8000H - 8FFFH
 - 2 K, 8000H - BFFFH
 - 16 K, 8000H - BFFFH
 - 2 K, 8000H - 8FFFH
32. A unity feedback system has $G(s) = \frac{K(s+12)}{(s+14)(s+18)}$. What is the value of K to yield 10% error in steady state?
- 672
 - 189
 - 100
 - 21
33. A unity feedback system has an open-loop transfer function $G(s) = \frac{K}{s(s+10)}$. If the damping ratio is 0.5, then what is the value of K?
- 150
 - 100
 - 50
 - 10
34. The loop transfer function of a system is $\frac{K}{s(s+1)(s+5)}$. The loop gain K is adjusted for inducing sustained oscillations. What is the value of K for this objective?
- 15
 - 25
 - 30
 - 45
35. The phenomenon known as 'Early effect' in a bipolar transistor refers to a reduction of the effective base-width caused by
- Electron-hole recombination at the base
 - The reverse-biasing of the base-collector junction
 - The forward-biasing of the emitter-base junction
 - The early removal of stored base charge during saturation to cut off switching
36. The number of roots of the equation $2s^4 + s^3 + 3s^2 + 5s + 7 = 0$ which lie in the right half of s plane is
- 0
 - 1
 - 2
 - 3

37. Thermal runaway in a transistor biased in the active region is due to

1. heating of the transistor.
2. change in β due to increase in temperature.
3. change in reverse collector saturation current due to rise in temperature.
4. base emitter voltage V_{BE} which decreases with rise in temperature.

Which of the above statements is/are correct ?

- (a) 1 and 2
- (b) 2 and 3
- (c) 3 only
- (d) 4 only

38. The majority carriers in an n-type semiconductor have an average drift velocity V_d in a direction perpendicular to a uniform magnetic field B . The electric field E induced due to Hall Effect acts in the direction

- (a) $V_d \times B$
- (b) $B \times V_d$
- (c) Along V_d
- (d) Opposite to V_d

39. When the number of poles is equal to the number of zeros, how many branches of root locus tend towards infinity ?

- (a) 1
- (b) 2
- (c) 0
- (d) Equal to number of zeros

40. The open-loop transfer function of a unity feedback control system is $(s) = \frac{1}{(s+2)^2}$. The

closed-loop transfer function will have poles at

- (a) $-2, -2$
- (b) $-2, -1$
- (c) $-2, \pm j$
- (d) $-2, 2$

41. Which one of the following statements is correct ?

- (a) Phase margin is always positive for stable feedback system.
- (b) Phase margin is always negative for stable feedback system.
- (c) Phase margin can be negative or positive for stable feedback system.
- (d) None of the above

42. A Tachometer has a sensitivity of 5 V/1000 rpm. The Gain constant of the Tachometer is

- (a) 0.48 V/rad/sec
- (b) 0.048 V/rad/sec
- (c) 4.8 V/rad/sec
- (d) 48 V/rad/sec

43. For a 3rd order system given below, what is the phase crossover frequency ?

$$G(s)H(s) = \frac{K}{s^3 + 6s^2 + 11s + 6}$$

- (a) $\sqrt{6}$
- (b) $\sqrt{11}$
- (c) $\pm \sqrt{11}$
- (d) $\pm \sqrt{6}$

44. Two compensators have transfer functions

$$G_1(s) = \frac{5(s+10)}{(s+50)} \text{ and } G_2(s) = \frac{(s+50)}{5(s+10)}$$

respectively.

- (a) Both are lag
- (b) Both are lead
- (c) G_1 is lead and G_2 is lag
- (d) G_1 is lag and G_2 is lead

45. A proportional plus derivative controller
1. has high sensitivity.
 2. increases the stability of the system.
 3. improves the steady-state accuracy.
- Which of the above statements are correct ?
- (a) 1, 2 and 3
 - (b) 1 and 2 only
 - (c) 1 and 3 only
 - (d) 2 and 3 only
46. In industrial control system, which one of the following methods is most commonly used in designing a system for meeting performance specifications ?
- (a) The transfer function is first determined and then either a lead compensation or lag compensation is implemented
 - (b) The transfer function is first determined and PID controllers are implemented by mathematically determining PID constants
 - (c) PID controllers are implemented without the knowledge of the system parameters using Ziegler - Nichols method
 - (d) PID controllers are implemented using Ziegler - Nichols method after determining the system transfer function
47. Which one of the following is the transfer function of the PI-controller ?
- (a) $G(s) = \frac{(k_1 s + k_2)}{k_3}$
 - (b) $G(s) = \frac{(k_1 s + k_2 s + k_3)}{k_4 s}$
 - (c) $G(s) = \frac{(k_1 s + k_2)}{k_3 s}$
 - (d) $G(s) = \frac{k_1 s}{k_2 s}$
48. One of the main functions of the RF amplifiers in a super-heterodyne receiver is to
- (a) Provide improved tracking
 - (b) Permit better adjacent channel rejection
 - (c) Increase the tuning range of the receiver
 - (d) Improve the rejection of the image frequency
49. An FM signal has a carrier swing of 100 kHz when modulating signal has a frequency of 8 kHz. The modulation index is
- (a) 12.5
 - (b) 7.5
 - (c) 6.25
 - (d) 15
50. In a digital communication system employing Frequency Shift Keying (FSK), the 0 and 1 bit are represented by sine waves of 10 kHz and 25 kHz respectively. These waveforms will be orthogonal for a bit interval of
- (a) 250 μ sec
 - (b) 200 μ sec
 - (c) 50 μ sec
 - (d) 45 μ sec
51. If a 400-watt carrier is amplitude modulated to a depth of 75 percent, what is the total power in the modulated wave ?
- (a) 517.5 W
 - (b) 463.3 W
 - (c) 448.5 W
 - (d) 512.5 W
52. The signal $m(t) = \text{sinc}(2 \times 10^4 t)$ is frequency modulated with $K = 10^3$ Hz/V. What is the maximum instantaneous frequency of the modulated signal when carrier frequency is 1 MHz ?
- (a) 0.999 MHz
 - (b) 0.998 MHz
 - (c) 1.002 MHz
 - (d) 1.001 MHz

53. Amplitude modulation is used for broadcasting because

- (a) It is more noise immune than other modulation systems
- (b) Compared with other systems it requires less transmitting power
- (c) Its use avoids receiver complexity
- (d) No other modulation system can provide the necessary BW for high fidelity

54. In flat-top sampling a hold circuit is sometimes required. This hold circuit can be designed as a sampler followed by

- (a) A shunt capacitor
- (b) An envelope detector
- (c) Parallel RC circuit
- (d) A series resistance along with parallel RC circuit in shunt

55. As compared to A-law compander, the μ -law compander produces

- (a) More companding at low amplitudes
- (b) More companding at high amplitudes
- (c) Less companding for low amplitudes
- (d) Less companding for high amplitudes

56. A carrier is modulated by a digital bit stream having one of the possible phases of 0° , 90° , 180° and 270° . Then the modulation is termed as

- (a) BPSK
- (b) QPSK
- (c) QAM
- (d) MSK

57. Consider the following :

1. Pulse-position modulation.
2. Pulse-code modulation.
3. Pulse-width modulation.

Which of the above communications are *not* digital ?

- (a) 1 and 2 only
- (b) 2 and 3 only
- (c) 1 and 3 only
- (d) 1, 2 and 3

58. In a superheterodyne receiver, if the intermediate frequency is 450 kHz and the signal frequency is 1000 kHz, then the local oscillator frequency and image frequency respectively are

- (a) 1450 kHz and 100 kHz
- (b) 550 kHz and 1900 kHz
- (c) 1450 kHz and 1900 kHz
- (d) 550 kHz and 1450 kHz

59. The cladding which surrounds the fibre core

- (a) is used to protect the fibre
- (b) is used to reduce optical interference
- (c) helps to guide the light in the core
- (d) ensures that refractive index remains unaltered

60. In microwave relay communication, the repeater is usually an amplifier for the amplification of

- (a) Carrier signal
- (b) Baseband signal
- (c) Amplitude modulated IF signal
- (d) Frequency modulated IF signal

61. In a geostationary satellite communication system, a message signal is transmitted from an earth station via an uplink to a satellite, amplified in a transponder on board the satellite and then transmitted via a downlink to another earth station. The most popular frequency band for satellite communication is
- 16 MHz for the uplink and 14 MHz for the downlink
 - 4 GHz for the uplink and 6 GHz for the downlink
 - 6 GHz for the uplink and 4 GHz for the downlink
 - 10 GHz for the downlink and 8 GHz for the uplink
62. As per WARC-1979 allocation, commercial communication satellites use bandwidth of
- 4 MHz
 - 40 MHz
 - 200 MHz
 - 500 MHz
63. Range resolution in RADAR is determined by
- The radiated power
 - The bandwidth of transmitted pulse
 - The antenna size
 - The centre frequency of RADAR
64. In satellite communication, Faraday rotation is caused by
- Plasma frequency
 - Earth's magnetic field
 - Non-Gaussian nature of uplink noise when received in the downlink channel
 - Ionospheric reflections that occur multiple times
65. What will be the total modulation index if a wave is amplitude modulated by three sine waves with modulation indices of 25%, 50% and 75% ?
- $M_t = 1.5$
 - $M_t = 0.93$
 - $M_t = 1.22$
 - $M_t = 1$
66. Boosting of higher frequency at the transmitter is done by using
- De-emphasis
 - AGC circuit
 - Pre-emphasis
 - Armstrong method
67. The power contained in single sideband in amplitude modulation is
- $\frac{m^2 P_c}{2}$
 - $2 m^2 P_c$
 - $\frac{m^2 P_c}{4}$
 - $4 m^2 P_c$
68. TWT is characterized by
- Low noise figure, narrow bandwidth and average gain
 - Gain exceeding 40 dB, wide bandwidth and low noise figure
 - More noise and wide bandwidth
 - More noise, narrow bandwidth and high gain

69. In Gunn diodes, electrons are transferred from

- (a) High to low mobility energy bands
- (b) Low to high mobility energy bands
- (c) Valley to domain formation
- (d) Domain to valley formation

70. Polarization is characteristic of EM wave that gives the direction of

- (a) Electrical component of a wave with respect to ground
- (b) Magnetic component of EM wave with respect to ground
- (c) Both electrical and magnetic components with respect to ground
- (d) None of the above

71. A rectangular waveguide has the dimensions of 5.1 cm × 2.4 cm. For the dominant mode TE₁₀ the cut-off frequency is

- (a) 2.94 GHz
- (b) 5.88 GHz
- (c) 6.25 GHz
- (d) 68.99 GHz

72. The semiconductor random access memory of a computer has 65,536 words, each of 8-bits. It can perform two basic operations Read and Write. How many bits are there in the Address Register of this memory ?

- (a) 8
- (b) 12
- (c) 16
- (d) 24

73.
$$S = \begin{bmatrix} 0 & 0 & S_{13} & S_{14} \\ 0 & 0 & S_{23} & S_{24} \\ S_{31} & S_{32} & 0 & 0 \\ S_{41} & S_{42} & 0 & 0 \end{bmatrix}$$

is the scattering matrix of

- (a) Magic Tee
- (b) Circulator
- (c) Hybrid ring
- (d) Three port network

74. Phase velocity v_p and group velocity v_g in a waveguide are related to the velocity of light c as

- (a) $v_p v_g = c^2$
- (b) $v_p + v_g = c$
- (c) $\frac{v_p}{v_g} = \text{Constant}$
- (d) $v_p + v_g = \text{Constant}$

75. Which one of the following is *not* a mode of operation of a Gunn diode ?

- (a) LSA oscillation mode
- (b) Stable amplification mode
- (c) Bias circuit oscillation mode
- (d) Non-linear mode

76. The only modes in microstrip lines are

- (a) TE modes
- (b) TM modes
- (c) TE and TEM modes
- (d) Quasi-transverse electric and magnetic modes

77. If the receiving antenna is polarized at 90° with respect to transmitting antenna, it will receive
- No signal
 - Minimum signal
 - Maximum signal
 - Same signal
78. Which of the following methods provides largest bandwidth ?
- Proximity coupling
 - Aperture coupling
 - Coaxial probe feed
 - Microstrip line feed
79. Which of the following antennas gives circular polarization ?
- Yagi-Uda
 - Parabolic
 - Helical
 - Dipole
- 1, 2, 3 and 4
 - 1, 2 and 3 only
 - 3 only
 - 4 only
80. If the diameter of a $\frac{\lambda}{2}$ dipole antenna is increased from $\frac{\lambda}{100}$ to $\frac{\lambda}{50}$, then its
- Bandwidth increases
 - Bandwidth decreases
 - Gain increases
 - Gain decreases
81. The efficiency of an antenna having a resistance of 30Ω and radiation resistance of 60Ω is
- 33.3%
 - 50%
 - 66.6%
 - 75%
82. An antenna behaves as a Resonant Circuit if
- Its length is integral multiple of $\frac{n\lambda}{2}$
 - Its height is integral multiple of $\frac{n\lambda}{2}$
 - Its length is even multiple of $\frac{n\lambda}{2}$
 - Its length is odd multiple of $\frac{n\lambda}{2}$
83. Magic Tee is called as
- E-H plane Tee
 - Hybrid Tee
 - Mixer circuit
 - All of the above
84. A transmission line has characteristic impedance of 500Ω . It has been terminated in a 200Ω load. If the load is dissipating a continuous power of 100 W , its reflection coefficient is
- $\frac{6}{7}$
 - $\frac{4}{7}$
 - $\frac{3}{7}$
 - $\frac{2}{7}$

85. Detection of microwaves is carried out by employing
- Vacuum tube diode
 - Semiconductor diode
 - Schottky Barrier diode
 - Field-Effect Transistor
86. The frequency range of very high frequency (VHF) is
- 300 MHz – 3000 MHz
 - 30 MHz – 300 MHz
 - 3 MHz – 30 MHz
 - 30 THz – 3000 Hz
87. On a microstrip line the wavelength measured is 12 mm for a 10 GHz signal. The dielectric constant of the equivalent homogeneous line is
- 3.5
 - 6.25
 - 5.5
 - 7.0
88. Microwave link repeaters are typically 50 km apart in TV transmission, because
- of atmospheric attenuation
 - of output power tube limitation
 - microwave transmission is through surface wave which attenuates faster
 - of Earth's curvature
89. The ratio $\frac{\sigma}{\omega \epsilon}$ is called
- Intrinsic ratio.
 - Loss tangent.
 - Conduction ratio.
 - Dissipation factor.
- Which of the above statements is/are correct ?
- 1 only
 - 2 only
 - 2 and 4
 - 2 and 3
90. Baretters and Bolometers are used for measurement of
- VSWR
 - Transmission losses
 - Microwave power
 - None of the above
91. The discone antenna is
- A useful direction finding antenna
 - Used as a radar receiving antenna
 - Circularly polarized like other circular antennas
 - Useful as VHF receiving antenna
92. A satellite link uses different frequencies for receiving and transmitting in order to
- Avoid interference from terrestrial microwave link
 - Minimize free space losses
 - Maximize antenna gain
 - Avoid interference between its powerful transmitted signal and weak incoming signal
93. The number of one's present in the binary representation of $15 \times 256 + 5 \times 16 + 3$ are
- 8
 - 9
 - 10
 - 11
94. The creation of file variable will automatically create a special variable associated with it, called as
- Buffer variable
 - Text variable
 - Allocated variable
 - Floating variable

95. Wrapping of data functions together in a class is known as
- Overloading
 - Data Abstraction
 - Polymorphism
 - Encapsulation
96. Given $(135)_{\text{base } x} + (144)_{\text{base } x} = (323)_{\text{base } x}$. What is the value of base x ?
- 5
 - 3
 - 12
 - 6
97. Expression $C = i++$ causes
- value of i to be assigned to C , and then i to be incremented by 1
 - i to be incremented by 1, and then value of i to be assigned to C
 - value of i to be assigned to C
 - i to be incremented by 1
98. The addressing mode that permits relocation, without any change whatsoever in the code, is
- Indirect addressing
 - Base register addressing
 - Indexed addressing
 - PC relative addressing
99. Which of the following algorithm design techniques is used in the quick sort algorithm ?
- Dynamic programming
 - Backtracking
 - Divide and conquer
 - Greedy method
100. An algorithm is made up of 2 modules M_1 and M_2 . If order of M_1 is $f(n)$ and that of M_2 is $g(n)$, then the order of the algorithm is
- $f(n) \times g(n)$
 - $f(n) + g(n)$
 - $\min(f(n), g(n))$
 - $\max(f(n), g(n))$
101. Which of the following sorting methods will be the best, if the number of swappings done, is the only measure of efficiency ?
- Bubble sort
 - Quick sort
 - Insertion sort
 - Selection sort
102. In a circularly linked list organization, insertion of a record involves the modification of
- No pointer
 - 1 pointer
 - 2 pointers
 - 3 pointers
103. The average successful search time for sequential search on 'n' items is
- $\frac{(n+1)}{2}$
 - $\frac{n}{2}$
 - $\frac{(n-1)}{2}$
 - $\log(n) + 1$
104. The speed mismatch between Processor and Memory in a computer is alleviated by using a small fast memory as an intermediate buffer between Memory and Processor. This buffer memory is known as
- Volatile ROM
 - Non-Volatile ROM
 - Cache Memory
 - EPROM

105. What is maximum number of nodes in a binary tree that has N levels, if the root level is zero ?
- 2^{2N}
 - $2^{N+1} - 1$
 - $2^N - 1$
 - $2^N - 2N$
106. To arrange a binary tree in ascending order, we need
- Post order traversal only
 - In order traversal only
 - Pre order traversal only
 - Post order traversal and Pre order traversal
107. The method used for resolving data dependency conflict by the compiler itself is
- Delayed load
 - Operand forwarding
 - Prefetch target instruction
 - Loop buffer
108. The micro programs provided by a manufacturer to be used on his micro programmed computer are generally called
- Software
 - Netware
 - Firmware
 - Hardware
109. Locality of reference concept will fall in which of the following cases ?
- Where there are
- Many conditional jumps
 - Many unconditional jumps
 - Many operands
 - None of the above
110. Consider the following statements regarding RESET instruction of 8085 microprocessor :
- PC contents become 0000H.
 - All interrupts are enabled.
 - RESET OUT pin is at logic 0.
- Which of the above statements is/are correct ?
- 1 only
 - 2 only
 - 1 and 2
 - 2 and 3
111. In a microprocessor, the register which holds address of the next instruction to be fetched is
- Accumulator
 - Program counter
 - Stack pointer
 - Instruction register
112. The following sequence of instructions is executed by an 8085 microprocessor :
- ```
1000 LXI SP, 27FF
1003 CALL 1006
1006 POP H
```
- The contents of the stack pointer (SP) and the HL register pair on completion of execution of these instructions are
- SP = 27 FF, HL = 1003
  - SP = 27 FD, HL = 1003
  - SP = 27 FF, HL = 1006
  - SP = 27 FD, HL = 1006
113. The semiconductor RAM of a digital computer has a word length of 16-bits and a capacity of 65,536 words. It has a cycle time of 80 ns. If the CPU is much faster than the memory, the time required to fill 1,024 bytes of this memory with all 0's will be
- 40.96  $\mu$ s
  - 81.92  $\mu$ s
  - 5.24 ms
  - 10.48 ms

**Directions :** Each of the next seven (07) items consists of two statements, one labelled as the 'Statement (I)' and the other as 'Statement (II)'. Examine these two statements carefully and select the answers to these items using the codes given below :

**Codes :**

- (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.

**114. Statement (I) :**

A NAND gate represents a universal logic family.

**Statement (II) :**

Only two NAND gates are sufficient to accomplish any of the basic gates.

**115. Statement (I) :**

Digital ramp converter is the slowest ADC.

**Statement (II) :**

It requires  $N^2$  clock pulses for conversion.

**116. Statement (I) :**

The  $\beta$  of a bipolar transistor is reduced, if the base width is increased.

**Statement (II) :**

The  $\beta$  of a bipolar transistor increases, if the doping concentration in the base is increased.

**117. Statement (I) :**

Space wave is used for propagation of FM broadcast system.

**Statement (II) :**

Several independent interference-free transmitters can be operated on the same frequency because of line-of-sight propagation.

**118. Statement (I) :**

In  $TE_{mn}$  modes Z component of magnetic field is non-zero.

**Statement (II) :**

In  $TE_{mn}$  modes Z component of electric field is non-zero.

**119. Statement (I) :**

On-chip Cache memory is used for temporary storage of commonly used code/data copied from the main memory.

**Statement (II) :**

Provision of Cache memory eliminates the need for the processor to go off the chip to access the main memory thus improving the processor performance.

**120. Statement (I) :**

In the main memory of a computer, RAM is used as a short-term memory.

**Statement (II) :**

RAM is a volatile memory.

**SPACE FOR ROUGH WORK**



**SPACE FOR ROUGH WORK**



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