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

T.B.C. : VBY–S–ELX **Test Booklet Series**

Serial No. 0046085

TEST BOOKLET

A

ELECTRONICS AND TELECOMMUNICATION ENGINEERING

Time Allowed : Three Hours **Maximum Marks : 300**

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 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 **150** 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 (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. Consider a common-emitter current gain of $\beta = 150$ and a base current of $i_B = 15\,\mu A$. If the transistor is biased in the forward active mode, the collector and emitter current will be

(a) 2·25 mA and 2·27 mA

(b) 3·25 mA and 2·27 mA

(c) 2·25 mA and 1·37 mA

(d) 3·25 mA and 1·37 mA

2. The input to a bridge rectifier is 230 V (r.m.s.), 50 Hz. The d.c. output voltage and the ripple factor with R_L of 100 Ω and capacitor filter of 1000 μF are

(a) 207 V and 0·028

(b) 325 V and 0·028

(c) 207 V and 0·020

(d) 325 V and 0·020

3. The effect of reduction in effective base width due to increase in reverse voltage of BJT is

(a) Hall effect

(b) Early effect

(c) Zener effect

(d) Miller effect

4. What is the drain current for a D-MOSFET having the characteristic values I_{DSS} of 10 mA, $V_{GS(off)}$ of – 4 V and V_{GS} of + 2 V?

(a) 22·5 mA

(b) 17·5 mA

(c) 12·5 mA

(d) 2·5 mA

5. In the Wien bridge oscillator, the 0° phase-shift is met by using lead-lag network and by using

(a) inverting op-amp

(b) non-inverting op-amp

(c) feedback op-amp

(d) high-gain op-amp

6. What is the frequency of oscillation for an *RC* phase-shift oscillator with *R* of 10 kΩ and *C* of 0·001 μF in each of its three *RC* sections?

(a) 5·0 kHz

(b) 5·5 kHz

(c) 6·0 kHz

(d) 6·5 kHz

7. When there is no clock signal applied to CMOS logic circuits, they are referred to as

(a) complex CMOS logic circuits

(b) static CMOS logic circuits

(c) NMOS transmission gates

(d) random PMOS logic circuits

8. One form of NMOS circuit logic that minimizes power dissipation and maximizes device density is called

(a) pass transistor logic

(b) sequential logic circuit

(c) NMOS SRAM cell

(d) NMOS transmission gate

9. The ideal op-amp has

(a) infinite voltage gain and zero input impedance

(b) infinite voltage gain and infinite bandwidth

(c) zero voltage gain and infinite CMRR

(d) zero output impedance and zero CMRR

10. A d.c. voltage supply provides 60 V when the output is unloaded. When connected to a load, the output drops to 56 V. The value of the voltage regulation is

(a) 3·7%

(b) 5·7%

(c) 7·1%

(d) 9·1%

11. In optical communication, the maximum angle in which external light rays may strike the air/glass interface and still propagate down the fiber is called as

(a) critical angle

(b) numerical aperture

(c) angle of refraction

(d) acceptance angle

12. The light intensity 3 m from a lamp that emits 25 W of light energy will be

(a) 243 mW/m^2

(b) 232 mW/m^2

(c) 221 mW/m^2

(d) 210 mW/m^2

13. Two resistances, one of 30 Ω and another of unknown value, are connected in parallel. The total power dissipated in the circuit is 450 W when the applied voltage is 90 V. The unknown resistance is

(a) 45 Ω

(b) 35 Ω

(c) 30 Ω

(d) 20 Ω

14. An electric kettle contains 1·5 kg of water at 15 °C. It takes 15 minutes to raise the temperature of water to 95 °C. If the heat loss due to radiations and heating the kettle is 15 kcalories and the supply voltage is 100 V, the current taken will be

(a) 8·0 A

(b) 7·1 A

(c) 6·3 A

(d) 5·4 A

15. A heater element is made of nichrome wire having resistivity equal to 100×10^{-8} Ω m and diameter of 0·4 mm. The length of the wire required to get a resistance of 40 Ω will be nearly

(a) 9 m

(b) 7 m

(c) 5 m

(d) 3 m

16. A car is travelling at 72 km/h. If the length of an axle is 2 m and the vertical component of the earth's magnetic field is 40 μWb/m^2, the e.m.f. generated in the axle of the car is

(a) 2·6 mV

(b) 2·2 mV

(c) 1·6 mV

(d) 1·2 mV

17. In a telephone receiver, the size of each of the two poles is 1·2 cm × 0·2 cm and the flux between each pole and the diaphragm is 3×10^{-6} Wb. The force attracted to the poles will be nearly

(a) 0·15 N

(b) 0·20 N

(c) 0·30 N

(d) 0·40 N

18. An inductor of 0·5 H inductance and 90 Ω resistance is connected in parallel with a 20 μF capacitor. A voltage of 230 V at 50 Hz is maintained across the circuit. The total power taken from the source is nearly

(a) 588 W

(b) 145 W

(c) 135 W

(d) 125 W

19. A 240 V shunt motor with the armature resistance of 0·1 Ω runs at 850 r.p.m. for an armature current of 70 A. If its speed is to be reduced to 650 r.p.m., the resistance to be placed in series for an armature current of 50 A is nearly

(a) 0·82 Ω

(b) 1·14 Ω

(c) 1·24 Ω

(d) 1·34 Ω

20. A 200 V d.c. shunt motor with armature resistance of 0·2 Ω and carrying a current of 50 A is running at 960 r.p.m. If the flux is reduced by 10% at constant torque and with negligible iron and friction losses, the speed will be nearly

(a) 1280 r.p.m.

(b) 1170 r.p.m.

(c) 1100 r.p.m.

(d) 1060 r.p.m.

21. Which of the following statements are correct for d.c. shunt motor?

1. Speed of a shunt motor is sufficiently constant.
2. For the same current input, its starting torque is not as high as that of a series motor.
3. The motor can be directly coupled to a load such as a fan whose torque increases with speed.

Select the correct answer using the code given below.

(a) 2 and 3 only

(b) 1 and 3 only

(c) 1 and 2 only

(d) 1, 2 and 3

22. Consider the following materials :

1. Lead peroxide
2. Sponge lead
3. Dilute sulphuric acid

Which of the above are active materials of a lead-acid battery?

(a) 1 and 2 only

(b) 1 and 3 only

(c) 2 and 3 only

(d) 1, 2 and 3

23. Which of the following statements are correct for a fully charged lead-acid cell?

1. Gassing occurs at both electrodes.
2. The terminal voltage is 2·6 V.
3. The specific gravity of the electrolyte is 1·21.

Select the correct answer using the code given below.

(a) 1 and 2 only

(b) 1 and 3 only

(c) 2 and 3 only

(d) 1, 2 and 3

24. Which of the following statements are correct for synchronous motors?

1. Synchronous motors are well-suited for direct connection to reciprocating compressors.
2. Over-excited synchronous motors are most commonly used for power factor improvement.
3. Synchronous motors are generally used for current regulation of long transmission lines.

Select the correct answer using the code given below.

(a) 1, 2 and 3

(b) 1 and 3 only

(c) 1 and 2 only

(d) 2 and 3 only

25. Which crystal system requires six lattice parameters to fully specify its unit cell?

(a) Triclinic

(b) Monoclinic

(c) Cubic

(d) Hexagonal

26. The minimum cation-to-anion radius ratio for the coordination number 3 is

(a) 0·175

(b) 0·155

(c) 0·135

(d) 0·115

27. Which of the following materials are categories of ceramic materials?

1. Oxides—Alumina, Zirconia
2. Non-oxides—Carbides, Borides, Nitrides and Silicides
3. Composites—Particulate reinforced combinations of oxides and non-oxides

Select the correct answer using the code given below.

(a) 1 and 2 only

(b) 1 and 3 only

(c) 2 and 3 only

(d) 1, 2 and 3

28. Consider the following data for copper :

Energy for vacancy formation is 0·9 eV/atom

Atomic weight is 63·5 g/mol

Density is 8·4 g/cm^3 at 1000 °C

The equilibrium number of vacancies per cubic meter at 1000 °C will be

(a) $3{\cdot}2\times10^{20}$

(b) $3{\cdot}2\times10^{25}$

(c) $2{\cdot}2\times10^{20}$

(d) $2{\cdot}2\times10^{25}$

29. Which of the following are electrical insulating materials?

1. Lucite
2. Mica
3. Bakelite

Select the correct answer using the code given below.

(a) 1 and 2 only

(b) 1 and 3 only

(c) 2 and 3 only

(d) 1, 2 and 3

30. The magnitude of the energy gap for an insulator is

(a) less than 1 eV

(b) between 2 eV to 3 eV

(c) more than 3 eV

(d) between 1 eV to 2 eV

31. In a 440 V, 50 Hz transformer, the total iron loss is 3700 W. When the applied voltage is 220 V at 25 Hz, the total iron loss is 750 W. The eddy current loss at the normal voltage and frequency will be

(a) 1000 W

(b) 1200 W

(c) 1400 W

(d) 1850 W

32. A transformer core is wound with a coil carrying an alternating current at a frequency of 50 Hz. The hysteresis loop has an area of 60000 units, when the axes are drawn in units of 10^{-4} Wb m^{-2} and 10^{2} A m^{-1}. If the magnetization is uniform throughout the core volume of $0 \cdot 01\, m^{3}$, then the hysteresis loss will be

(a) 200 W

(b) 230 W

(c) 270 W

(d) 300 W

33. The process of evaporating a metal in an inert atmosphere and allowing it to condense on the surface of a cold finger, which is kept at liquid nitrogen temperature of 77 K, is known as

(a) d.c. arc method

(b) gas-phase condensation

(c) sonohydrolysis

(d) flame pyrolysis

34. Which one of the following materials is having the highest electrical conductivity at room temperature?

(a) Silver

(b) Copper

(c) Gold

(d) Platinum

35. Consider the following processes :

1. Sol-gel process
2. Electrodeposition
3. Plasma-enhanced vapour decomposition
4. Gas-phase condensation
5. Sputtering technique

The above processes are related to

(a) analysis of nano-powders

(b) sintering of nano-powders

(c) synthesis of nano-powders

(d) microwave sintering of nano-powders

36. In the superconducting state, the flux lines of a magnetic field are ejected out of the superconductor as per

(a) Curie effect

(b) Faraday's effect

(c) Maxwell's effect

(d) Meissner effect

37. A null type of instrument as compared to a deflection type of instrument

(a) has a higher accuracy

(b) is less sensitive

(c) is more rugged

(d) is faster in response

38. A Wheatstone bridge requires a change of 7 Ω in the unknown resistance arm of the bridge to produce a change in deflection of 3 mm of the galvanometer. The sensitivity and the deflection factor will be nearly

(a) 0·23 mm/Ω and 2·3 Ω/mm

(b) 0·43 mm/Ω and 2·3 Ω/mm

(c) 0·23 mm/Ω and 1·3 Ω/mm

(d) 0·43 mm/Ω and 1·3 Ω/mm

39. The galvanometer used in a Wheatstone bridge as a detector can detect a current as low as 0·1 nA and its resistance is negligible compared to internal resistance of the bridge. Each arm of the bridge has a resistance of 1 kΩ. The input voltage applied to the bridge is 20 V. The smallest change in the resistance that can be detected is

(a) 10 μΩ

(b) 20 μΩ

(c) 30 μΩ

(d) 40 μΩ

40. The inductance of a 25 A electrodynamic ammeter changes uniformly at the rate of 0·0035 μH/degree. The spring constant is 10^{-6} N m/degree. The angle of deflection at full scale will be

(a) 135°

(b) 125°

(c) 115°

(d) 105°

41. A resistance is determined by voltmeter-ammeter method. The voltmeter reads 100 V with a probable error of ±12 V and the ammeter reads 10 A with a probable error of ± 2 A. The probable error in the computed value of the resistance will be nearly

(a) 0·6 Ω

(b) 1·3 Ω

(c) 2·3 Ω

(d) 3·6 Ω

42. A temperature-sensing device can be modeled as a first-order system with a time constant of 6 s. It is suddenly subjected to a step input of 25 °C–150 °C. The indicated temperature in 10 s after the process has started will be

(a) 118·2 °C

(b) 126·4 °C

(c) 134·6 °C

(d) 142·8 °C

43. In a parallel circuit having two branches, the current in one branch is $I_1 = 100 \pm 2$ A and in the other is $I_2 = 200 \pm 5$ A. Considering errors in both I_1 and I_2 as limiting errors, the total current will be

(a) 300 ± 5 A

(b) 300 ± 6 A

(c) 300 ± 7 A

(d) 300 ± 8 A

44. A 0–150 V voltmeter has a guaranteed accuracy of 1% of full-scale reading. The voltage measured by this instrument is 75 V. The limiting error will be

(a) 5%

(b) 4%

(c) 3%

(d) 2%

45. A quartz piezoelectric crystal having a thickness of 2 mm and voltage sensitivity of 0·055 V m/N is subjected to a pressure of 1·5 MN/m^2. The voltage output will be

(a) 165 V

(b) 174 V

(c) 183 V

(d) 192 V

46. A resistance wire strain gauge with a gauge factor of 2 is bonded to a steel structural member subjected to a stress of 100 MN/m^2. The modulus of elasticity of steel is 200 GN/m^2. The change in the value of gauge resistance due to the applied stress will be

(a) 0·05%

(b) 0·10%

(c) 0·30%

(d) 0·60%

47. The applications of photomultipliers are seen in

(a) night vision equipment, medical equipment

(b) mechanical counters, timers

(c) translational, optical instruments

(d) ultrasonic transducer, infrared imaging

48. A capacitance of 250 pF produces resonance with a coil at a frequency of $\left(\frac{2}{\pi}\right) \times 10^6$ Hz, while at the second harmonic of this frequency, resonance is produced by a capacitance of 50 pF. The self-capacitance of the coil will be nearly

(a) 16·7 pF

(b) 20·5 pF

(c) 24·3 pF

(d) 28·1 pF

49. Consider the following data for twigs and links :

N = Number of nodes

L = Total number of links

B = Total number of branches

The total number of links associated with a tree is

(a) $B - N + 1$

(b) $B - N - 1$

(c) $B + N + 1$

(d) $2B - N + 1$

50. In *ABCD* parameters, *A* and *C* are called

(a) reverse current ratio and transfer admittance

(b) reverse voltage ratio and transfer impedance

(c) reverse current ratio and transfer impedance

(d) reverse voltage ratio and transfer admittance

51. A coil having resistance of 10 Ω and inductance of 1 H is switched on to a direct voltage of 100 V. The steady-state value of the current will be

(a) 10 A

(b) 15 A

(c) 20 A

(d) 25 A

52. A coil has $R = 10\ \Omega$ and $L = 15$ H. The voltage at the instant when the current is 10 A and increasing at the rate of 5 A/s will be

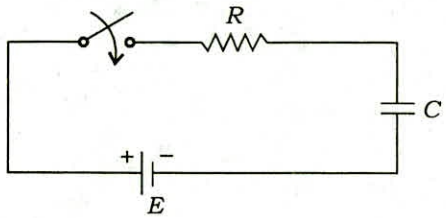
(a) 125 V

(b) 150 V

(c) 175 V

(d) 200 V

53. Consider the following *RC* circuit. The capacitor has an initial charge q_0 such that it opposes the flow of charging current :



The response of the circuit $i(t)$ will be

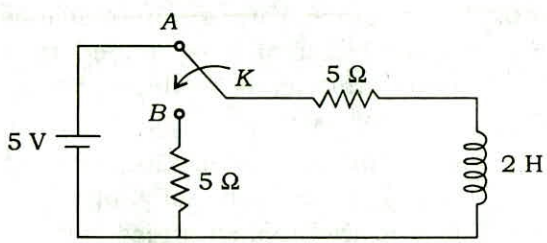
(a) $\left(\frac{E}{R} - \frac{q_0}{RC}\right) e^{-\frac{t}{RC}}$

(b) $-\frac{q_0}{RC} e^{-\frac{t}{RC}}$

(c) $\frac{E}{R} e^{-\frac{t}{RC}}$

(d) $\left(\frac{E}{R} + \frac{q_0}{RC}\right) e^{-\frac{t}{RC}}$

54. In the following circuit, switch *K* is thrown from position *A* to position *B* at time $t = 0$, the current having previously reached its steady state :



The current $i(t)$ after switching will be

(a) $5e^{-5t}$

(b) $4e^{-5t}$

(c) $3e^{-5t}$

(d) e^{-5t}

55. What is the condition for reciprocity and symmetry in Y-parameter representation?

(a) $Y_{21} = Y_{11}$ and $Y_{22} = Y_{21}$

(b) $Y_{21} = Y_{12}$ and $Y_{11} = Y_{22}$

(c) $Y_{21} = Y_{22}$ and $Y_{11} = Y_{22}$

(d) $Y_{11} = Y_{22}$ and $Y_{21} = Y_{22}$

56. In hybrid parameters, h_{11} and h_{21} are called as

(a) input impedance and forward current gain

(b) reverse voltage gain and output admittance

(c) input impedance and reverse voltage gain

(d) output impedance and forward current gain

57. Consider the following equations :

$$V_1 = 6V_2 - 4I_2$$

$$I_1 = 7V_2 - 2I_2$$

A, B, C and D parameters are

(a) 6, −4 Ω, 7 mho and −2

(b) 6, 4 Ω, 7 mho and 2

(c) −6, 4 Ω, −7 mho and 2

(d) 6, 4 Ω, −7 mho and −2

58. A supply of 250 V, 50 Hz is applied to a series RC circuit. If the power absorbed by the resistor be 400 W at 160 V, the value of the capacitor C will be nearly

(a) 30·5 μF

(b) 41·5 μF

(c) 64·0 μF

(d) 76·8 μF

59. A 50 Hz sinusoidal voltage $V = 311\sin \omega t$ is applied to an RL series circuit. If the magnitude of resistance is 5 Ω and that of the inductance is 0·02 H, the r.m.s. value of the steady-state current and the relative phase angle are nearly

(a) 19·6 A and 51·5°

(b) 27·4 A and −51·5°

(c) 19·6 A and −51·5°

(d) 27·4 A and 51·5°

60. In a series RC circuit, the values of $R = 10\ \Omega$ and $C = 25$ nF. A sinusoidal voltage of 50 MHz is applied and the maximum voltage across the capacitance is 2·5 V. The maximum voltage across the series combination will be nearly

(a) 172·7 V

(b) 184·5 V

(c) 196·3 V

(d) 208·1 V

61. The peak-to-peak ripple voltage for a half-wave rectifier and filter circuit operating at 60 Hz, which has a 680 μF reservoir capacitor, an average output of 28 V and 200 Ω load resistance, will be nearly

(a) 2·5 V

(b) 3·4 V

(c) 4·3 V

(d) 5·2 V

62. The components of full-wave voltage doubler circuit are

(a) 2 diodes and 1 capacitor

(b) 4 diodes and 1 capacitor

(c) 2 diodes and 2 capacitors

(d) 4 diodes and 2 capacitors

63. An amplifier has a signal input voltage V_i of 0·25 V and draws 1 mA from the source. If the amplifier delivers 8 V to a load of 10 mA, the power gain is

(a) 340

(b) 320

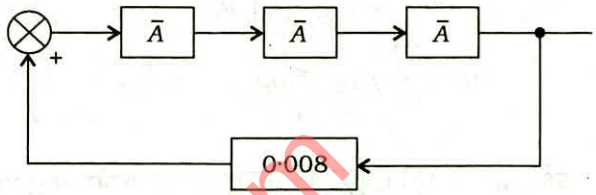
(c) 250

(d) 150

64. Three amplifiers of gain

$$\bar{A} = \left(\frac{A_0}{2}\right) \angle -60°$$

are connected in tandem. The feedback loop is closed through a positive gain of 0·008 :



The magnitude of A_0 for the system to be oscillatory will be

(a) 0·2

(b) 0·1

(c) 5·0

(d) 10·0

65. The output voltage from a 5-bit ladder type DAC that has a digital input of 11010, and by assuming 0 = 0 V and 1 = + 10 V, is nearly

(a) 26·0 V

(b) 16·3 V

(c) 10·3 V

(d) 8·1 V

66. An 8-bit D/A converter has step size of 20 mV. The full-scale output and the resolution will be nearly

(a) 5·1 V and 0·3%

(b) 4·6 V and 0·4%

(c) 5·1 V and 0·4%

(d) 4·6 V and 0·3%

67. For 555 astable multivibrator, if $C = 0 \cdot 01\ \mu F$, $R_A = 10\ k\Omega$, $R_B = 50\ k\Omega$, the frequency and the duty cycle will be nearly

(a) 1·6 kHz and 54·5%

(b) 1·3 kHz and 54·5%

(c) 1·6 kHz and 46·5%

(d) 1·3 kHz and 46·5%

68. Consider the following expression :

$$A \cdot B \cdot C \cdot D + A \cdot B \cdot \overline{C} \cdot \overline{D} + A \cdot B \cdot C \cdot \overline{D} + A \cdot B \cdot \overline{C} \cdot D + A \cdot B \cdot C \cdot D \cdot E + A \cdot B \cdot \overline{C} \cdot \overline{D} \cdot \overline{E} + A \cdot B \cdot \overline{C} \cdot D \cdot E$$

The simplification of this by using theorems of Boolean algebra will be

(a) $A + B$

(b) $A \oplus B$

(c) $(A + B)(A \cdot B)$

(d) $A \cdot B$

69. An electric power generating station supplies power to three loads *A*, *B* and *C*. Only a single generator is required when any one load is switched on. When more than one load is on, an auxiliary generator must be started. The Boolean equation for the control of switching of the auxiliary generator will be

(a) $AA + BB + CC$

(b) $ABC + BCA + CAB$

(c) $AB + AC$

(d) $AB + AC + BC$

70. Which one of the following types of instructions will be used to copy from the source to the destination location?

(a) Arithmetic instructions

(b) Data transfer instructions

(c) Logical instructions

(d) Machine control instructions

71. A cascaded arrangement of flip-flops, where the output of one flip-flop drives the clock input of the following flip-flop, is known as

(a) synchronous counter

(b) ripple counter

(c) ring counter

(d) up counter

72. The number of flip-flops required to construct an 8-bit shift register will be

(a) 32

(b) 16

(c) 8

(d) 4

73. Which one of the following specifications does ***not*** fit for a single-mode fiber?

(a) The bandwidth is 1 GHz/km.

(b) The digital communication rate is excess of 2000 Mbytes/s.

(c) More than 100000 voice channels are available.

(d) The mode field diameter (MFD; spot size) is larger than the core diameter.

74. For a binary FSK signal with a mark frequency of 49 kHz, a space frequency of 51 kHz and an input bit rate of 2 kbps, the peak frequency deviation will be

(a) 0·5 kHz

(b) 1·0 kHz

(c) 2·0 kHz

(d) 4·0 kHz

75. A random process $X(t)$ is defined as

$$X(t) = 2\cos(2\pi t + Y)$$

where Y is a discrete random variable with $P(Y = 0) = \frac{1}{2}$ and $P\left(Y = \frac{\pi}{2}\right) = \frac{1}{2}$. The mean $\mu_x(1)$ is

(a) $\frac{1}{4}$

(b) $\frac{1}{3}$

(c) $\frac{1}{2}$

(d) 1

76. A source produces three symbols A, B and C with probabilities $P(A) = \frac{1}{2}$, $P(B) = \frac{1}{4}$ and $P(C) = \frac{1}{4}$. The source entropy is

(a) $\frac{1}{2}$ bit/symbol

(b) 1 bit/symbol

(c) $1\frac{1}{4}$ bits/symbol

(d) $1\frac{1}{2}$ bits/symbol

77. An AM wave with modulation index 0·8 has total sideband power of 4·85 kW. The carrier power and the total power radiated will be nearly

(a) 12·2 kW and 20 kW

(b) 15·2 kW and 20 kW

(c) 12·2 kW and 25 kW

(d) 15·2 kW and 25 kW

78. A 360 W carrier is simultaneously modulated by two audio waves with modulation percentages of 55 and 65 respectively. The effective modulation index and the total power radiated are

(a) 0·85 and 490·5 W

(b) 0·65 and 490·5 W

(c) 0·85 and 450·5 W

(d) 0·65 and 450·5 W

79. An amplitude modulated amplifier has a radio frequency output of 50 W at 100% modulation. The internal loss in the modulator is 10 W. The unmodulated carrier power is

(a) 40 W

(b) 50 W

(c) 60 W

(d) 80 W

80. For an FM receiver with an input signal-to-noise ratio of 29 dB, a noise figure of 4 dB and an FM improvement factor of 16 dB, the pre-detection and post-detection signal-to-noise ratios are

(a) 25 dB and 41 dB

(b) 30 dB and 49 dB

(c) 25 dB and 49 dB

(d) 30 dB and 41 dB

81. For Gaussian and White channel noise, the capacity of a low-pass channel with a usable bandwidth of 3000 Hz and $\frac{S}{N} = 10^3$ at the channel output will be

(a) 15000 bits/s

(b) 20000 bits/s

(c) 25000 bits/s

(d) 30000 bits/s

82. For a PM modulator with a deviation sensitivity $K = 2 \cdot 5$ rad/V and a modulating signal $v_m(t) = 2\cos(2\pi\, 2000t)$, the peak phase deviation m will be

(a) 1·25 rad

(b) 2·5 rad

(c) 5·0 rad

(d) 7·5 rad

83. In a PCM system, non-uniform quantization leads to

(a) increased quantizer noise

(b) simplification of the quantization process

(c) higher average SNR

(d) increased bandwidth

84. The bandwidth required in DPCM is less than that of PCM because

(a) the number of bits per code is reduced resulting in a reduced bit rate

(b) the difference signal is larger in amplitude than actual signal

(c) more quantization levels are needed

(d) the successive samples of signal often differ in amplitude

85. For the given transfer function

$$G(s) = \frac{Y(s)}{R(s)} = \frac{1}{s^2 + 3s + 2}$$

the response $y(t)$ for a step input $r(t) = 5u(t)$ will be

(a) $\left[\frac{5}{2} - 5e^{-t} + \frac{5}{2}e^{-2t}\right]u(t)$

(b) $\left[\frac{5}{2} - 5e^{-t}\right]u(t)$

(c) $\left[\frac{5}{2} + \frac{5}{2}e^{-2t}\right]u(t)$

(d) $\left[-5e^{-t} + \frac{5}{2}e^{-2t}\right]u(t)$

where $u(t)$ is a unit step input.

86. The price for improvement in sensitivity by the use of feedback is paid in terms of

(a) loss of system gain

(b) rise of system gain

(c) improvement in transient response, delayed response

(d) poor transient response

87. Consider a feedback system with the characteristic equation

$$1 + K\frac{1}{s(s+1)(s+2)} = 0$$

The asymptotes of the three branches of root locus plot of this system will form the following angles with the real axis

(a) 60°, 120° and 300°

(b) 60°, 120° and 180°

(c) 60°, 180° and 300°

(d) 40°, 120° and 200°

88. If the characteristic equation of a feedback control system is given by

$$s^4 + 20s^3 + 15s^2 + 2s + K = 0$$

then the range of values of K for the system to be stable will be

(a) $1 < K < 2 \cdot 49$

(b) $0 < K < 1 \cdot 49$

(c) $1 < K < 4 \cdot 49$

(d) $0 < K < 3 \cdot 49$

89. For a Type–2 system, the steady-state errors for unit step and unit ramp input are

(a) 0 and ∞

(b) ∞ and 0

(c) 0 and 0

(d) ∞ and ∞

90. Consider the following statements regarding a parabolic function :

1. A parabolic function is one degree faster than the ramp function.
2. A unit parabolic function is defined as

$$f(t) = \begin{cases} \frac{t^2}{2}, & \text{for } t > 0 \\ 0, & \text{otherwise} \end{cases}$$

3. Laplace transform of unit parabolic function is $\frac{1}{s^3}$.

Which of the above statements are correct?

(a) 1 and 2 only

(b) 1 and 3 only

(c) 2 and 3 only

(d) 1, 2 and 3

91. Consider the following open-loop transfer function :

$$G = \frac{K(s+2)}{(s+1)(s+4)}$$

The characteristic equation of the unity negative feedback will be

(a) $(s+1)(s+4)+K(s+2)=0$

(b) $(s+2)(s+1)+K(s+4)=0$

(c) $(s+1)(s-2)+K(s+4)=0$

(d) $(s+2)(s+4)+K(s+1)=0$

92. The magnitude and phase relationship between the sinusoidal input and the steady-state output of a system is called as

(a) magnitude response

(b) transient response

(c) steady-state response

(d) frequency response

93. A transfer function having all its poles and zeros only in the left-half of the *s*-plane is called

(a) a minimum-phase transfer function

(b) a complex transfer function

(c) an all-pass transfer function

(d) a maximum-phase transfer function

94. The frequency where magnitude M has a peak value in frequency response is known as

(a) normalized frequency

(b) resonant frequency

(c) peak frequency

(d) tuned frequency

95. For a lead compensator having transfer function

$$G_c(s) = \frac{(s+z_c)}{(s+p_c)} = \frac{(s+\frac{1}{\tau})}{(s+\frac{1}{\alpha\tau})}$$

1. $\alpha = \frac{z_c}{p_c} < 1$
2. $\alpha = \frac{z_c}{p_c} > 1$
3. $\tau > 0$
4. $\tau < 0$

Which of the above are correct?

(a) 1 and 4

(b) 1 and 3

(c) 2 and 4

(d) 2 and 3

96. The attenuation (magnitude) produced by a lead compensator at the frequency of maximum phase lead $\omega_m = \sqrt{ab}$ is

(a) $\sqrt{\frac{b}{a}}$ (b) $\sqrt{a+b}$

(c) $\sqrt{b-a}$ (d) $\sqrt{\frac{a}{b}}$

97. Consider the following statements :

1. A computer will have a multiply instruction.
2. Multiply instruction will be implemented by a special multiply unit.

Which of the following is correct?

(a) Both 1 and 2 are not architectural design issues.

(b) Both 1 and 2 are not organizational issues.

(c) 1 is an architectural design issue while 2 is an organizational issue.

(d) 1 is an organizational issue while 2 is an architectural design issue.

98. Consider a disk with an average seek time of 4 ms, rotational delay of 2 ms, rotation speed of 15000 r.p.m. and 512-byte sectors with 500 sectors per track. A file occupies all of the sectors on 5 adjacent tracks. After reading the first track, if remaining tracks can be read with no seek time, then the time required in sequential organization to transfer the file will be nearly

(a) 0·01 second

(b) 0·034 second

(c) 0·34 second

(d) 3·4 seconds

99. Add 8 and 9 in BCD code.

(a) 00010111

(b) 00010001

(c) 01110111

(d) 10001001

100. Convert the binary number 11000110 to Gray code.

(a) 00100101

(b) 10100100

(c) 11100110

(d) 10100101

101. The decimal value of the signed binary number 10101010 expressed in 2's complement will be

(a) −42

(b) −86

(c) −116

(d) −170

102. Which of the following statements is/are correct?

1. An address generated by the CPU is commonly referred to as a physical address.
2. An address seen by the memory unit is commonly referred to as a logical address.
3. The run-time mapping from virtual to physical address is done by the memory management unit (MMU).

Select the correct answer using the code given below.

(a) 1 only

(b) 2 only

(c) 3 only

(d) 1, 2 and 3

103. In a cache with 64-byte cache lines, how many bits are used to determine which byte within a cache line an address points to?

(a) 16

(b) 8

(c) 6

(d) 3

104. A system has 64-bit virtual addresses and 43-bit physical addresses. If the pages are 8 kB in size, the number of bits required for VPN and PPN will be respectively

(a) 51 bits and 30 bits

(b) 30 bits and 51 bits

(c) 51 bits and 13 bits

(d) 30 bits and 13 bits

105. A soft error is a

(a) regular-nondestructive event

(b) random-nondestructive event

(c) random-destructive event

(d) regular-destructive event

106. A main memory can hold 3 page frames and initially all of them are vacant. Consider the following stream of page requests :

2, 3, 2, 4, 6, 2, 5, 6, 1, 4, 6

If the stream uses FIFO replacement policy, the hit ratio h will be

(a) $\frac{11}{3}$

(b) $\frac{1}{11}$

(c) $\frac{3}{11}$

(d) $\frac{2}{11}$

107. Which one of the following is an advantage of assembly language over high-level language?

(a) Assembly language program runs faster.

(b) Writing of assembly language programming is easy.

(c) Assembly language program is portable.

(d) Assembly language program contains less instruction.

108. Which of the following statements are correct?

1. A pseudoinstruction is a machine instruction.
2. A pseudoinstruction is an instruction to the assembler.
3. The ORG (origin) is an example of pseudoinstruction.
4. It is not possible to use ORG more than once in a program.

Select the correct answer using the code given below.

(a) 1 and 3

(b) 2 and 3

(c) 1 and 4

(d) 2 and 4

109. The vector R_{AB} extends from $A(1, 2, 3)$ to B. If the length of R_{AB} is 10 units and its direction is given by

$$a = 0 \cdot 6a_x + 0 \cdot 64a_y + 0 \cdot 48a_z$$

the coordinates of B will be

(a) $7a_x + 4 \cdot 8a_y + 4 \cdot 8a_z$

(b) $6a_x + 6 \cdot 4a_y + 4 \cdot 8a_z$

(c) $7a_x + 8 \cdot 4a_y + 7 \cdot 8a_z$

(d) $6a_x + 8 \cdot 4a_y + 7 \cdot 8a_z$

110. What is the value for the total charge enclosed in an incremental volume of 10^{-9} m^3 located at the origin if

$$D = e^{-x} \sin y\, a_x - e^{-x} \cos y\, a_y + 2z a_z \ C/m^2 ?$$

(a) 8 nC

(b) 4 nC

(c) 2 nC

(d) 1 nC

111. The unit vector extending from origin toward the point $G(2, -2, -1)$ is

(a) $\frac{2}{3}a_x + \frac{2}{3}a_y + \frac{1}{3}a_z$

(b) $-\frac{2}{3}a_x + \frac{2}{3}a_y + \frac{1}{3}a_z$

(c) $\frac{2}{3}a_x - \frac{2}{3}a_y - \frac{1}{3}a_z$

(d) $-\frac{2}{3}a_x - \frac{2}{3}a_y - \frac{1}{3}a_z$

112. Ground waves progress along the surface of the earth and must be polarized

(a) horizontally

(b) circularly

(c) elliptically

(d) vertically

113. For a lossless line terminated in a short circuit, the stationary voltage minima and maxima are separated by

(a) $\frac{\lambda}{8}$

(b) $\frac{\lambda}{2}$

(c) $\frac{\lambda}{3}$

(d) $\frac{\lambda}{4}$

114. The characteristic impedance of an 80 cm long lossless transmission line having $L = 0{\cdot}25$ μH/m and $C = 100$ pF/m will be

(a) 25 Ω

(b) 40 Ω

(c) 50 Ω

(d) 80 Ω

115. It is required to match a 200 Ω load to a 300 Ω transmission line to reduce the SWR along the line to 1. If it is connected directly to the load, the characteristic impedance of the quarter-wave transformer used for this purpose will be

(a) 275 Ω

(b) 260 Ω

(c) 245 Ω

(d) 230 Ω

116. For a standard rectangular waveguide having an aspect ratio of 2 : 1, the cutoff wavelength for $TM_{1,1}$ mode will be nearly

(a) $0{\cdot}9a$

(b) $0{\cdot}7a$

(c) $0{\cdot}5a$

(d) $0{\cdot}3a$

117. The irises in the rectangular metallic waveguide may be

1. inductive
2. resistive
3. capacitive

Select the correct answer using the code given below.

(a) 1, 2 and 3

(b) 1 and 2 only

(c) 1 and 3 only

(d) 2 and 3 only

118. A 10 GHz signal is propagated in a waveguide whose wall separation is 6 cm. The greatest number of half-waves of electric intensity will be possible to establish between the two walls. The guide wavelength for this mode of propagation will be

(a) 6·48 cm

(b) 4·54 cm

(c) 2·48 cm

(d) 1·54 cm

119. In $TE_{m,n}$ mode, m and n are integers denoting the number of

(a) $\frac{1}{2}$ the wavelengths of intensity between each pair of walls

(b) $\frac{1}{3}$ the wavelengths of intensity between each pair of walls

(c) $\frac{1}{4}$ the wavelengths of intensity between each pair of walls

(d) $\frac{1}{8}$ the wavelengths of intensity between each pair of walls

120. Consider the following statements with reference to dipole arrays :

1. In broadside array, all the dipoles are fed in the same phase from the same source.
2. In end-fire array, the magnitude of the current in each element is same and there is no phase difference between these currents.

Which of the above statements is/are correct?

(a) 1 only

(b) 2 only

(c) Both 1 and 2

(d) Neither 1 nor 2

121. Which of the following are the advantages of Silicon over Insulator (SOI)?

1. Lower diffusion capacitance
2. Smaller parasitic delay and lower dynamic power consumption
3. Lower threshold voltages

Select the correct answer using the code given below.

(a) 1, 2 and 3

(b) 1 and 2 only

(c) 1 and 3 only

(d) 2 and 3 only

122. The finite state machine in which

1. the output is a function of the current state and inputs
2. the output is a function of only the current state

Which of the following machines are respectively correct for these styles?

(a) Mealy machine and Moore machine

(b) Moore machine and Mealy machine

(c) State machine and Mealy machine

(d) State machine and State machine

123. In EPROMs, applying a high voltage to the upper gate causes electrons to jump through the thin oxide onto the floating gate through the process known as

(a) mask programming

(b) one-time programming

(c) avalanche injection or Fowler-Nordheim tunneling

(d) erasing

124. What is the range of values of a and b for which the linear time-invariant system with impulse response

$$h(n) = \begin{cases} a^n, & n \geq 0 \\ b^n, & n < 0 \end{cases}$$

is stable?

(a) Both $|a| < 1$ and $|b| > 1$ are satisfied

(b) Both $|a| > 1$ and $|b| < 1$ are satisfied

(c) Both $|a| > 1$ and $|b| > 1$ are satisfied

(d) Both $|a| < 1$ and $|b| < 1$ are satisfied

125. The special case of a finite-duration sequence is given as

$$x(n) = \{2, 4, 0, 3\}$$
$$\uparrow$$

The sequence $x(n)$ into a sum of weighted impulse sequences will be

(a) $2\delta(n+1) + 4\delta(n) + 3\delta(n-2)$

(b) $2\delta(n) + 4\delta(n-1) + 3\delta(n-3)$

(c) $2\delta(n) + 4\delta(n-1) + 3\delta(n-2)$

(d) $2\delta(n+1) + 4\delta(n) + 3\delta(n-1)$

126. The two advantages of FIR filters over IIR filters are

(a) they are guaranteed to be stable and non-linear

(b) they are marginally stable and linear

(c) they are guaranteed to be stable and may be constrained to have linear phase

(d) they are marginally stable and non-linear

127. The frequency response and the main lobe width for rectangular window are

(a) $\dfrac{\sin\frac{\omega N}{2}}{\sin\frac{\omega}{2}}$ and $\dfrac{4\pi}{N}$

(b) $\dfrac{\sin\frac{\omega N}{2}}{\frac{\omega}{2}}$ and $\dfrac{\pi}{N}$

(c) $\dfrac{\sin\frac{\omega}{2}}{\sin\frac{\omega N}{2}}$ and $\dfrac{2\pi}{N}$

(d) $\dfrac{\sin\frac{\omega N}{4}}{\sin\frac{\omega}{2}}$ and $\dfrac{8\pi}{N}$

128. A controller that takes control of the buses and transfers data directly between source and destination bypassing the microprocessor is known as

(a) DMA controller

(b) read-write controller

(c) high-speed controller

(d) master-slave controller

129. A 2-byte instruction which accepts the data from the input port specified in the second byte and loads into the accumulator is

(a) OUT <8-bit port address>

(b) IN <8-bit port address>

(c) OUT R <8-bit port address>

(d) IN R <8-bit port address>

130. Consider the following instruction :

EI

MVI A, 08H

SIM

It means

(a) disable all interrupts

(b) enable all interrupts

(c) disable RST 7·5 and 6·5

(d) enable RST 7·5 and 6·5

131. The instruction BC 0x15 means

(a) jump 15 bytes relative to the program counter

(b) copy and load 15 words in reverse direction to the program counter

(c) move to a location by 15 bits to the program counter

(d) redirect (jump) to a location by 15 words relative to the program counter

132. Which of the following constraints are to be considered by the designer while designing an embedded system?

1. Selecting the microcontroller as a controlling device
2. Selecting the language to write the software
3. Partitioning the tasks between hardware and software to optimize the cost

Select the correct answer using the code given below.

(a) 1, 2 and 3

(b) 1 and 2 only

(c) 1 and 3 only

(d) 2 and 3 only

133. Which one of the following is the correct combination for a layer providing a service by means of primitives in an open systems interconnection?

(a) Request, Indication, Response and Confirm

(b) Request, Inform, Response and Service

(c) Request, Command, Response and Action

(d) Request, Confirm, Indication and Action

134. A network uses a fully interconnected mesh topology to connect 10 nodes together. The number of links required will be

(a) 35

(b) 40

(c) 45

(d) 50

135. Which of the following are the advantages of packet switching?

1. Greater link efficiency than circuit switching
2. Connections are not blocked when traffic congestion occurs
3. Direct channel established between transmitter and receiver
4. No time is taken to establish connection

Select the correct answer using the code given below.

(a) 1 and 3

(b) 1 and 2

(c) 2 and 3

(d) 3 and 4

136. A message consisting of 2400 bits is to be passed over an internet. The message is passed to the transport layer which appends a 150-bit header, followed by the network layer which uses a 120-bit header. Network layer packets are transmitted via two networks, each of which uses a 26-bit header. The destination network only accepts up to 900 bits long. The number of bits, including headers delivered to the destination network, is

(a) 2706 bits

(b) 2634 bits

(c) 2554 bits

(d) 2476 bits

137. In a communication network, 4 T1 streams are multiplexed to form 1 T2 stream and 7 T1 streams are multiplexed to form 1 T3 stream. Further 6 T3 streams are multiplexed to form 1 T4 stream. If each T1 stream is of 1·544 Mbps, the data rate of 1 T4 stream should be

(a) 211·8 Mbps

(b) 232·6 Mbps

(c) 243·4 Mbps

(d) 274·2 Mbps

138. Which of the following statements are correct regarding CDMA?

1. It is similar to GSM.
2. It allows each station to transmit over the entire frequency spectrum all the time.
3. It assumes that multiple signals add linearly.

Select the correct answer using the code given below.

(a) 1 and 2 only

(b) 1 and 3 only

(c) 2 and 3 only

(d) 1, 2 and 3

139. Which of the following regarding cellular systems with small cells are correct?

1. Higher capacity and robustness
2. Needless transmission power and have to deal with local interference only
3. Frequency planning and infrastructure needed
4. These require both circuit switching and packet switching

Select the correct answer using the code given below.

(a) 1, 2 and 4

(b) 1, 3 and 4

(c) 1, 2 and 3

(d) 2, 3 and 4

140. A satellite is orbiting in the equatorial plane with a period from perigee to perigee of 12 h. If the eccentricity = 0·002, $i = 0°$, $K_1 = 66063 \cdot 17\ km^2$, $\mu = 3 \cdot 99 \times 10^{14}\ m^3/s^2$ and the earth's equatorial radius = 6378·14 km, the semi-major axis will be

(a) 34232 km

(b) 30424 km

(c) 26612 km

(d) 22804 km

141. A single-mode optical fiber has a beat length of 8 cm at 1300 nm. The value of birefringence B_f will be nearly

(a) $1 \cdot 6 \times 10^{-5}$

(b) $2 \cdot 7 \times 10^{-5}$

(c) $3 \cdot 2 \times 10^{-5}$

(d) $4 \cdot 9 \times 10^{-5}$

142. Which one of the following instruments is useful while measuring the optical power as a function of wavelength?

(a) Optical power attenuator

(b) Optical power meter

(c) Optical spectrum analyzer

(d) Optical return loss tester

143. The optical performance monitoring involves

(a) transport layer monitoring, optical signal monitoring and protocol performance monitoring

(b) physical layer, network layer and application layer monitoring

(c) data-link layer, presentation layer and session layer monitoring

(d) transport layer, session layer and application layer monitoring

144. An earth station at sea level communicates at an elevation angle of 35° with GEO satellite. The vertical height of the stratiform rain is 3 km. The physical path length L through the rain will be nearly

(a) 6·3 km

(b) 5·2 km

(c) 4·1 km

(d) 3·0 km

Directions :

The following **six (6)** items consist of two statements, one labelled as 'Statement (I)' and the other as 'Statement (II)'. You are to 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

145. Statement (I) :

Sign-magnitude representation is rarely used in implementing the integer portion of the ALU.

Statement (II) :

There are two representations of zero in sign-magnitude representation.

146. Statement (I) :

Dynamic loading gives better memory-space utilization.

Statement (II) :

In dynamic loading, an unused routine is never loaded.

147. Statement (I) :

SRAM is used for cache memory and DRAM is used for main memory.

Statement (II) :

SRAM is somewhat faster than DRAM.

148. Statement (I) :

In a multiuser system, each user is assigned a section of usable memory area and is not allowed to go out of the assigned memory area.

Statement (II) :

In multiuser system, there is a software mechanism to prevent unauthorized access of memory by different users.

149. Statement (I) :

The external surface of a crystal is an imperfection in itself as the atomic bonds do not extend beyond the surface.

Statement (II) :

The external surfaces have surface energies that are related to the number of bonds broken at the surface.

150. Statement (I) :

By organizing various 'optical functions' into an 'array structure' via nano-pattern replication, 'spatial integration' is established.

Statement (II) :

By adding a nano-optic layer or layers to functional optical materials, the 'hybrid integration' is possible to be achieved.

SPACE FOR ROUGH WORK