CCE(P) - 2015
ELECTRONICS

KTM–14–XV

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

Subject Code : 1 4

Test Booklet No. : 00942

TEST BOOKLET

ELECTRONICS

Time Allowed : 2 (Two) Hours **Full Marks : 200**

INSTRUCTIONS

1. The name of the Subject, Roll Number as mentioned in the Admission Certificate, Test Booklet No. and Subject Code shall be written legibly and correctly in the space provided on the Answer Sheet with black ball pen.
2. **Space provided for Series in the Answer Sheet is not applicable for Optional Subject. So the space shall be left blank.**
3. All questions carry equal marks. Your total marks will depend only on the number of correct responses marked by you in the Answer Sheet.
4. No candidate shall be admitted to the Examination Hall/Room 20 minutes after commencement of distribution of the paper. The Supervisor of the Examination Hall/Room will be the time-keeper and his/her decision in this regard is final.
5. No candidate shall leave the Examination Hall/Room without prior permission of the Supervisor/ Invigilator. No candidate shall be permitted to hand over his/her Answer Sheet and leave the Examination Hall/Room before expiry of the full time allotted for each paper.
6. No Mobile Phone, Pager, etc., are allowed to be carried inside the Examination Hall/Room by the candidates. Any Mobile Phone, Pager, etc., found in possession of the candidate inside the Examination Hall/Room, even if on off mode, shall be liable for confiscation.
7. No candidate shall have in his/her possession inside the Examination Hall/Room any book, notebook or loose paper, except his/her Admission Certificate and other connected paper permitted by the Commission.
8. Complete silence must be observed in the Examination Hall/Room. No candidate shall copy from the paper of any other candidate, or permit his/her own paper to be copied, or give, or attempt to give, or obtain, or attempt to obtain irregular assistance of any kind.
9. 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.
10. Violation of any of the above Rules will render the candidate liable to expulsion from the Examination Hall/Room and disqualification from the Examination, and according to the nature and gravity of his/her offence, he/she may be debarred from future Examinations and Interviews conducted by the Commission for appointment to Government Service.
11. Smoking inside the Examination Hall/Room is strictly prohibited.
12. **This Test Booklet contains one sheet (two pages) for Rough Work at the end.**

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[No. of Questions : 100]

SEAL

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ELECTRONICS

1. How many 200 W/220 V incandescent lamps connected in series would consume the same total power as a single 100 W/220 V incandescent lamp?

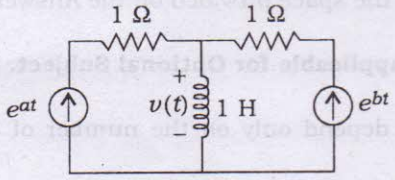
(A) Not possible

(B) 4

(C) 3

(D) 2

2. In the circuit given below, what will be the value of voltage $v(t)$?



(A) $e^{at} + e^{bt}$

(B) $e^{at} - e^{bt}$

(C) $ae^{at} + be^{bt}$

(D) $ae^{at} - be^{bt}$

3. An electric circuit with 10 branches and 7 nodes will have how many independent loops?

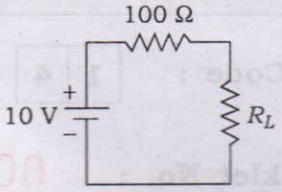
(A) 3

(B) 4

(C) 7

(D) 10

4. In the circuit given below



the maximum power that can be transferred to the load resistance R_L from the voltage source will be

(A) 1 W

(B) 10 W

(C) 0·25 W

(D) 0·5 W

5. In a linear circuit, the superposition principle can be applied to calculate the

(A) voltage and power

(B) current and power

(C) voltage and current

(D) voltage, current and power

6. A series *R-L-C* circuit has resonance frequency of 1 kHz and a quality factor $Q = 100$. If each of R, L and C is doubled from its original value, the new Q of the circuit is

(A) 25

(B) 50

(C) 100

(D) 200

7. The nodal method of circuit analysis is based on

(A) KVL and Ohm's law

(B) KCL and Ohm's law

(C) KCL and KVL

(D) KCL, KVL and Ohm's law

8. In a series R-L-C circuit, $R = 2\,k\Omega$, $L = 1\,H$ and $C = \frac{1}{400}\,\mu F$. The resonance frequency is

(A) 2×10^4 Hz

(B) $\frac{1}{\pi} \times 10^4$ Hz

(C) 10^4 Hz

(D) $2\pi \times 10^4$ Hz

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

(A) 3 A, 8 Ω

(B) 6 A, 8 Ω

(C) 0 A, 2 Ω

(D) 6 A, 2 Ω

10. Which of the following theorems can be applied to any network, i.e., linear or non-linear, active or passive, time variant or time invariant?

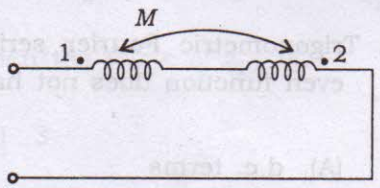
(A) Thevenin's theorem

(B) Norton's theorem

(C) Tellegen's theorem

(D) Superposition theorem

11. The equivalent inductance measured between terminals 1 and 2 for the circuit given in the figure below is



(A) $L_1 + L_2 + M$

(B) $L_1 + L_2 - M$

(C) $L_1 + L_2 + 2M$

(D) $L_1 + L_2 - 2M$

12. A signal $x(t)$ has a Fourier transform $X(\omega)$. If $x(t)$ is a real and odd function of t, then $X(\omega)$ is

(A) a real and even function of ω

(B) an imaginary and odd function of ω

(C) an imaginary and even function of ω

(D) a real and odd function of ω

13. Two coils have self-inductances of 0·09 H and 0·01 H, and a mutual inductance of 0·015 H. The coefficient of coupling between the two coils is

(A) 0·06

(B) 0·5

(C) 0·05

(D) 1·0

14. Trigonometric Fourier series of an even function does not have the

(A) d.c. terms

(B) cosine terms

(C) sine terms

(D) odd harmonic terms

15. Which of the following cannot be the Fourier series?

(A) $x(t) = 2\cos t + 3\cos 3t$

(B) $x(t) = 2\cos \pi t + 7\cos t$

(C) $x(t) = \cos t + 0 \cdot 5$

(D) $x(t) = 2\cos 1 \cdot 5\pi t + \sin 3 \cdot 5\cos \pi t$

16. Which of the following functions is a periodic one?

(A) $\sin(10\pi t) + \sin(20\pi t)$

(B) $\sin(10t) + \sin(20\pi t)$

(C) $\sin(10\pi t) + \sin(20t)$

(D) $\sin(10t) + \sin(25t)$

17. Which of the following conditions is true for even function?

(A) $f(t) = f(n \pm T/2)$

(B) $f(t) = -f(t)$

(C) $f(t) = f(-t)$

(D) $f(t) = f(T)$

18. The z-transform $F(z)$ of the function $f(nT) = a^{nT}$ is

(A) $\frac{z}{z - a^T}$

(B) $\frac{z}{z + a^T}$

(C) $\frac{z}{z - a^{-T}}$

(D) $\frac{z}{z + a^{-T}}$

19. The band gap of silicon at room temperature is

(A) 1·3 eV

(B) 0·7 eV

(C) 1·1 eV

(D) 1·4 eV

20. Which of the following will act at short circuit at $t = 0^+$ with zero initial condition?

(A) Resistor

(B) Capacitor

(C) Inductor

(D) None of the above

21. A function $f(\theta)$ satisfies the relation $f(-\theta) = -f(\theta)$ when this function contains

(A) only cosine terms

(B) only sine terms

(C) both cosine and sine terms

(D) None of the above

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

(A) Zero

(B) A step function

(C) A ramp function

(D) An impulse function

23. A two-port network is defined by the relation

$$I_1 = 5V_1 + 3V_2$$
$$I_2 = 2V_1 - 7V_2$$

Then the value of z_{12} is

(A) 3

(B) –3

(C) 3/41

(D) 2/31

24. The Laplace transform of the function $i(t)$ is

$$I(s) = \frac{10s + 4}{s(s + 1)(s^2 + 4s + 5)}$$

Its final value will be

(A) 4/5

(B) 5/4

(C) 4

(D) 5

25. What is the inverse Laplace transform of $\frac{e^{-as}}{\delta}$?

(A) e^{-at}

(B) $u(t-a)$

(C) $\delta(t-a)$

(D) $(t-a)u(t-a)$

26. The ratio of mobility to diffusion coefficient in a semiconductor has the unit

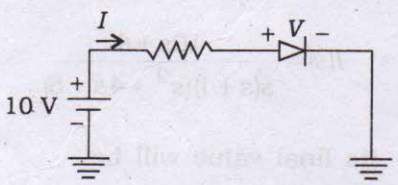
(A) V^{-1}

(B) $cm.V^{-1}$

(C) $V.cm^{-1}$

(D) V.s.

27. Assume that the diode is ideal, the values of I and V for the circuit given in the figure below are respectively



(A) 3·7 mA, 0 V

(B) 0 A, 10 V

(C) 0 A, 3·7 V

(D) 10 mA, 0 V

28. The impurity commonly used for realizing the base region of a silicon *n-p-n* transistor is

(A) gallium

(B) indium

(C) boron

(D) phosphor

29. An *n*-channel JFET has $I_{DSS} = 2$ mA, $V_p = -4$ V. Its transconductance g_m (in m℧) for an applied gate-to-source voltage V_{GS} of −2 V is

(A) 0·25

(B) 0·5

(C) 0·75

(D) 1·0

30. If for an Si *n-p-n* transistor the base-to-emitter voltage (V_{BE}) is 0·7 V and collector-to-base voltage (V_{CB}) is 0·2 V, then the transistor is operating in the

(A) normal active

(B) saturation

(C) inverse active

(D) cutoff

31. According to free-electron theory, electrons in metals are subjected to

(A) constant potential

(B) sinusoidal potential

(C) square-wave potential

(D) non-periodic potential

32. A material is said to be super-conductor when its resistance is

(A) very small

(B) negative

(C) zero

(D) None of the above

33. The band gap of a semiconductor is 1·43 eV. Its cutoff wavelength is

(A) 1 μm

(B) 0·81 μm

(C) 0·56 μm

(D) 0·27 μm

34. The Fermi function of an electron is $f(E)$, where E is energy. Then the Fermi function of a hole is

(A) $f(E)$

(B) $1-f(E)$

(C) $1+f(E)$

(D) $1/f(E)$

35. Typical value of ionization energy of an electron for n-type semi-conductor can be about

(A) 0·001 eV

(B) 0·01 eV

(C) 1·1 eV

(D) 0·15 eV

36. The current gain of a BJT is

(A) $g_m r_0$

(B) g_m / r_0

(C) $g_m r_\pi$

(D) g_m / r_π

37. Introducing a resistor in the emitter of a CE amplifier stabilizes the d.c. operating point against variation in

(A) only temperature

(B) only β of the transistor

(C) both temperature and β

(D) None of the above

38. The electron and hole concentrations in an intrinsic semiconductor are n_i and p_i respectively, when doped with p-type material, these change to n and p respectively. Then

(A) $n + p = n_i + p_i$

(B) $n + n_i = p + p_i$

(C) $np_i = n_i p$

(D) $np = n_i p_i$

39. The carrier mobility in a semiconductor is $0{\cdot}4\ m^2/Vs$. Its diffusion constant at 300 K will be (in m^2/s)

(A) 0·43

(B) 0·16

(C) 0·04

(D) 0·01

40. The unit of q/kT is

(A) V

(B) V^{-1}

(C) J

(D) J/K

41. A 741-type opamp has a gain bandwidth product of 1 MHz. A non-inverting amplifier using this opamp and having a voltage gain of 20 dB will exhibit –3 dB bandwidth of

(A) 50 kHz

(B) 100 kHz

(C) 1000/17 kHz

(D) 1000/7·07 kHz

42. Cross-over distortion behaviour is a characteristic of

(A) class A output stage

(B) class B output stage

(C) class AB output stage

(D) common base output stage

43. In an n-type silicon crystal at room temperature, which of the following can have a concentration of 4×10^{19} cm^{-3} ?

(A) Silicon atoms

(B) Holes

(C) Dopant atoms

(D) Valence electrons

44. I_{CBO} in a transistor can be reduced by reducing

(A) I_B

(B) V_{CC}

(C) I_E

(D) temperature

45. In a common-collector amplifier, the voltage gain

(A) is constant

(B) is less than unity

(C) varies with input

(D) varies with load

46. The number of bits in the binary representation of decimal number 16 is

(A) 6

(B) 5

(C) 4

(D) 3

47. The value of 2^5 in octal system is

(A) 40

(B) 20

(C) 400

(D) 200

48. Which of the following hexadecimal numbers represents an odd decimal number?

(A) FF

(B) EG

(C) CC

(D) AA

49. One's complement of 010001 is

(A) 101110

(B) 101111

(C) 01110

(D) 011110

50. The Boolean expression

$$X = B + A \cdot \overline{B} + AB$$

is equivalent to

(A) $A + B$

(B) $\overline{A} \cdot B$

(C) $\overline{A + B}$

(D) AB

51. The AND function can be realized by using only n number of NOR gates. What is the value of n?

(A) 2

(B) 3

(C) 4

(D) 5

52. What is the number of select lines required in a single-input n-output demultiplexer?

(A) 2

(B) n

(C) 2^n

(D) $\log_2 n$

53. The complement of $(A + BC + AB)$ is

(A) $\overline{A}(\overline{B} + \overline{C})$

(B) $\overline{A}\,\overline{B}\,\overline{C}$

(C) $A\overline{B}\overline{C}$

(D) $A(\overline{B} + \overline{C})$

54. A positive AND gate is also a negative

(A) NAND gate

(B) NOR gate

(C) AND gate

(D) OR gate

55. A multiplexer is also a

(A) counter

(B) decoder

(C) data selector

(D) None of the above

56. The number of flip-flops required in a decade counter is

(A) 2

(B) 3

(C) 4

(D) 5

57. The bipolar technology giving the fastest logic family is

(A) DTL

(B) TTL

(C) ECL

(D) None of the above

58. Which of the following logic gates dissipates maximum power?

(A) RTL

(B) TTL

(C) CMOS

(D) ECL

59. A *J-K* flip-flop can be made from an *S-R* flip-flop by using two additional

(A) NAND gates

(B) OR gates

(C) NOT gates

(D) NOR gates

60. *D* flip-flop can be made from *J-K* flip-flop by making

(A) $J = K$

(B) $J = K = 1$

(C) $J = 0, K = 1$

(D) $J = \overline{K}$

61. A square wave with a period of 10 μs drives a *T* flip-flop. The period of the output signal will be

(A) 100 μs

(B) 20 μs

(C) 10 ms

(D) 5 ms

62. A ring counter consisting of five flip-flops will have

(A) 5 states

(B) 10 states

(C) 32 states

(D) infinite states

63. The resolution of a 4-bit counting ADC is 0·5 V. For an analog input of 6·6 V, the digital output of the ADC will be

(A) 1011

(B) 1101

(C) 1100

(D) 1110

64. For standard TTL, the logic '0' has a voltage level between

(A) 0 V and 1 V

(B) 0 V and 0·8 V

(C) 0 V and 0·5 V

(D) 0 V and 0·4 V

65. Extremely low power dissipation and low cost per gate can be achieved in

(A) ECL

(B) CMOS

(C) TTL

(D) MOS

66. If F_S is the sampling frequency, the relation between analog frequency F and digital frequency f is

(A) $f = \frac{F}{2F_S}$

(B) $f = \frac{F_S}{F}$

(C) $f = \frac{F}{F_S}$

(D) $f = \frac{2F}{F_S}$

67. Which of the following signals is the example of deterministic signal?

(A) Step

(B) Ramp

(C) Exponential

(D) All of the above

68. The ROC of the sequence $x(n) = u(-n)$ is

(A) $|z| > 1$

(B) $|z| < 1$

(C) No ROC

(D) $-1 < |z| < 1$

69. The system function

$$H(z) = \frac{z^3 - 2z^2 + z}{z^2 + 0 \cdot 25z + 0 \cdot 125}$$

is

(A) causal

(B) non-causal

(C) unstable but causal

(D) Cannot be defined

70. Fourier transform of the signum function $x(t) = \text{sgn}(t)$ is

(A) $2 / \omega$

(B) $2 / j\omega$

(C) $2 / (j\omega)^2$

(D) $-2 / j\omega$

71. Let c_n be a Fourier coefficient in exponential form. It is given that $c_n = 2 + j7$. Then $c_{-\bar{n}}$ is

(A) $-2 - j7$

(B) $+2 - j7$

(C) $-2 + j7$

(D) $2 + j7$

72. The channel capacity of a noiseless channel is equal to the

(A) rate of transmission

(B) signalling speed

(C) bandwidth

(D) bandwidth-SNR product

73. In an amplitude-modulated signal, when the modulation index is one, then the maximum power P_t (where P_c is the carrier power) is equal to

(A) P_c

(B) $1 \cdot 5P_c$

(C) $2P_c$

(D) $2 \cdot 5P_c$

74. One of the drawbacks of FM is

(A) high noise

(B) limited range

(C) low signal strength

(D) None of the above

75. Thermal noise power is proportional to

(A) B

(B) $\sqrt{B}$

(C) $1/B^2$

(D) B^2

76. A signal occupies a band 5 kHz to 10 kHz. For proper error-free reconstruction, at what rate should it be sampled?

(A) 10 kHz

(B) 20 kHz

(C) 5 kHz

(D) $(10+5)\times 2$ kHz

77. Which of the following pulse modulations is analog?

(A) PCM

(B) Differential PCM

(C) PWM

(D) Delta

78. Which of the following modulation techniques is most affected by noise?

(A) ASK

(B) PSK

(C) FSK

(D) MSK

79. In FDM system used for telephone, which scheme is adopted?

(A) AM

(B) DSB-SC

(C) SSB-SC

(D) FM

80. Which of the following multiplexing techniques involved signal composed of light beam?

(A) CDM

(B) FDM

(C) TDM

(D) WDM

81. For separating the channels in TDM, one has to use

(A) differentiator

(B) integrator

(C) bandpass filter

(D) AND gates

82. To address the memory 14 bits are used. Then what will be the address of last memory location?

(A) 16382

(B) 16383

(C) 16384

(D) 16385

83. In 8085 μP, the RST6 istruction transfers the programme execution to the location

(A) 30H

(B) 24H

(C) 48H

(D) 60H

84. After execution of line 7 of the programme, the status of the *CY* and *Z* flags will be

(A) $CY = 0,\ Z = 0$

(B) $CY = 0,\ Z = 1$

(C) $CY = 1,\ Z = 0$

(D) $CY = 1,\ Z = 1$

85. With clock frequency of 3 MHz, the execution time for the instruction 'STA addr' of 8085 will be

(A) 3975 ns

(B) 3115 ns

(C) 4333 ns

(D) 3960 ns

86. Which of the following interrupts is both level and edge sensitive?

(A) RST 5–5

(B) INTER

(C) TRAP

(D) RST 7–5

87. The programmable internal timer is

(A) 8253

(B) 8251

(C) 8250

(D) 8275

88. Each machine cycle of 8051 corresponds to

(A) 4 clock cycles

(B) 3 clock cycles

(C) 6 clock cycles

(D) 12 clock cycles

89. Which of the following modes is not used in 8085 μP?

(A) Register

(B) Relative

(C) Immediate

(D) Indirect register

90. Which of the following types of stacks is used in 8085 μP?

(A) FIFO

(B) FILO

(C) LIFO

(D) LILO

91. Carry flag is not affected after execution of

(A) ADD B

(B) SBB B

(C) INR B

(D) ORA B

92. Division by zero in a programme gives rise to which one of the following errors?

(A) Syntax

(B) Logical

(C) Run time

(D) Semantic

93. Which of the following analog modulation schemes requires the minimum transmitter power and minimum channel bandwidth?

(A) VSB

(B) DSB-SC

(C) SSB

(D) AM

94. If $S(f)$ is the power spectral density of a real, wide-sense stationary random process, then which of the following is always true?

(A) $S(0) \geq f(t)$

(B) $S(f) \geq 0$

(C) $S(-f) = -S(f)$

(D) $\int_{-\infty}^{\infty} S(f)\, df = 0$

95. A communication channel with additive white Gaussian noise has a bandwidth of 4 kHz and an SNR of 15. The channel capacity is

(A) 1·6 kbps

(B) 16 kbps

(C) 32 kbps

(D) 256 kbps

96. The maximum PCM bit rate that can be supported by the system without introducing ISI (in bit per sec) is

(A) 2666·66

(B) 5333·33

(C) 8000

(D) 10000

97. The input of a matched filter is given by

$$s(t) = \begin{cases} 10\sin(2\pi \times 10^6 t), & 0 < t < 10^{-4} \text{ sec} \\ 0 \quad , & \text{otherwise} \end{cases}$$

The peak amplitude of the filter output is

(A) 10 V

(B) 5 V

(C) 10 mV

(D) 5 mV

98. In a digital communication system, employing FSK, the '0' and '1' bits are represented by sine waves of 10 kHz and 25 kHz respectively. The waveform will be orthogonal for a bit interval of

(A) 45 μs

(B) 200 μs

(C) 50 μs

(D) 250 μs

99. At a given probability of error, binary coherent FSK is inferior to binary coherent PSK by

(A) 6 dB

(B) 3 dB

(C) 2 dB

(D) 0 dB

100. Where are the stack and stack pointer located?

(A) Both reside in memory

(B) Both reside in CPU

(C) Former resides in CPU and the later in memory

(D) Former resides in memory and the later in CPU