MIZORAM PUBLIC SERVICE COMMISSION

COMPETITIVE EXAMINATIONS FOR RECRUITMENT TO THE POST OF
INSPECTOR OF LEGAL METROLOGY UNDER FOOD, CIVIL SUPPLIES & CONSUMER AFFAIRS DEPARTMENT, GOVERNMENT OF MIZORAM, DECEMBER, 2018

ELECTRONICS & COMMUNICATION ENGINEERING
PAPER - I

Time Allowed : 2 hours   Full Marks : 200

All questions carry equal marks of two (2) each.
Attempt all questions.

1. Total number of electrons that can be accommodated in various electron states in a valence band of a given solid is equal to
   - (a) The atomic number of the solid
   - (b) Half the number of the atoms in the solid
   - (c) The number of atoms in the solid
   - (d) Twice the number of the atoms in the solid

2. Ionic bonding in solids depends primarily on
   - (a) Transfer of electrons
   - (b) Sharing of electrons
   - (c) Electrical dipoles
   - (d) All of these

3. One electron volt is equal to
   - (a) 1.6×10^{-19} Joule
   - (b) 54.6×10^{-9} Joule
   - (c) 4.6×10^{-12} Joule
   - (d) 1.3×10^{-7} Joule

4. Atomic number of Silicon is
   - (a) 12
   - (b) 10
   - (c) 08
   - (d) 14

5. The bandgap of silicon at room temperature is
   - (a) 1.1 eV
   - (b) 6.6 eV
   - (c) 0 eV
   - (d) 9 eV

6. At 0°K semiconductor materials have same structure as _____ except the difference in the size of band gap.
   - (a) Metals
   - (b) Semiconductors
   - (c) Insulators
   - (d) None of these

7. Which material is the semiconductor?
   - (a) Al
   - (b) Cu
   - (c) Ge
   - (d) SiO_2

8. The width of the energy band depends on which of the following?
   - (a) Temperature
   - (b) Pressure
   - (c) Relative freedom of electrons in the crystal
   - (d) Mass of atom in the material

9. The material not having a negative temperature coefficient of resistivity are
   - (a) Metals
   - (b) Semiconductors
   - (c) Insulators
   - (d) None of these

10. Materials, whose specific resistance abruptly falls at very low temperature, are called
    - (a) Conductors
    - (b) Semiconductors
    - (c) Superconductors
    - (d) Insulators

11. A 'hole' in a semiconductor has
    - i) Positive charge equal to the electron charge
    - ii) Positive mass equal to the mass of the electron
    - iii) An 'effective mass' greater than the 'effective mass' of electron
    - iv) Negative mass and positive charge equal to the charge in nucleus

    Which of these statements are correct?
    - (a) i, ii, iii, iv
    - (b) i & iii only
    - (c) ii & iv only
    - (d) iii & iv only

12. Fermi level is the
    - (a) Highest occupied energy level at 0 K
    - (b) Highest occupied energy level at 0° C
    - (c) Energy level at which electron emission occurs
    - (d) Minimum energy level in the conduction band

13. An intrinsic semiconductor has equal number of electrons and holes. This is due to
    - (a) Doping
    - (b) Free electrons
    - (c) Thermal energy
    - (d) Valance electrons

14. With an increase in temperature, the Fermi level in an intrinsic semiconductor
    - (a) Move closer to the conduction band edge
    - (b) Move closer to the valance band edge
    - (c) Move into the conduction band
    - (d) Remains at the center of the forbidden gap

15. Silicon is not suitable for fabrication of light emitting diodes because it is
    - (a) An indirect band gap semiconductor
    - (b) A direct band gap semiconductor
    - (c) A wide band gap semiconductor
    - (d) A narrow band gap semiconductor

16. The mobility of electrons in a semiconductor is defined as the
    - (a) Diffusion velocity per unit electric field
    - (b) Diffusion velocity per unit magnetic field
    - (c) Drift velocity per unit electric field
    - (d) Drift velocity per unit magnetic field

17. The diffusion current is proportional to
    - (a) Applied electric field
    - (b) Square of the electric field
    - (c) Concentration gradient of charge carrier
    - (d) None of these

18. Two different categories of piezoelectric materials are:
    - (a) Natural group and Synthetic group
    - (b) Ceramic group and Optical group
    - (c) Conducting group and Non conducting group
    - (d) None of these

19. There are two types of Ferrites, they are
    - (a) Soft Ferrites and Hard Ferrites
    - (b) Simple Ferrites and Complex Ferrites
    - (c) Dark Ferrites and Light Ferrites
    - (d) Back Ferrites and Front Ferrites

20. The potential barrier existing across a P-N junction
    (a) Prevents flow of minority carriers
    (b) Prevents neutralization of acceptor and donor ions
    (c) Prevents total recombination of holes and electrons
    (d) Facilitates recombination of holes and electrons

21. With the increase of reverse bias in a p-n diode, the reverse current
    (a) Decreases
    (b) Increases
    (c) Remains constant
    (d) May increase or decrease depending upon doping

22. Which of the following is a "hot carrier diode"?
    (a) PIN diode   (b) LED
    (c) Photo diode   (d) Schottky diode

23. The type of transistor preferred in IC technology is
    (a) pnp   (b) pnpn
    (c) npn   (d) pnp-npn

24. The current I_{CBO} flows in the
    (a) Emitter and base leads   (b) Collector and base leads
    (c) Emitter and collector leads   (d) None of these

25. A zener regulator has an input voltage from 20 V to 30 V. The load current varies from 10 mA to 15 mA. If the Zener voltage is 5 V, the value of series resistor will be
    (a) 1 Kw   (b) 1.5 Kw
    (c) 1.66 Kw   (d) 2.5 Kw

26. Transistor is in saturation when
    (a) $I_B = I_C$ *(b)* $I_B > \dfrac{I_C}{\beta_{dc}}$

    (c) $I_B = 0$ *(d)* $I_B < \dfrac{I_C}{\beta_{dc}}$

27. Early effect is the modulation of effective base width by
    (a) Emitter voltage   (b) Emitter current
    (c) Collector voltage   (d) Junction temperature

28. FET is a _____ device.
    (a) Unipolar   (b) Bipolar
    (c) Tripolar   (d) None of these

29. FET terminals are:
    (a) Base, Emitter, Collector   (b) Gate, Base, Bulk
    (c) Gate, Source, Base   (d) Gate, Source, Drain

30. How many layers of material does a transistor have?
    (a) 4   (b) 3
    (c) 2   (d) 1

**31.** When the positive voltage on the gate of a p-channel JFET is increased, its drain current
    (a) Increases   (b) Decreases
    (c) Remains the same   (d) None of these

32. MOSFET can be used as
    (a) Current controlled capacitor   (b) Voltage controlled capacitor
    (c) Current controlled inductor   (d) Voltage controlled inductor

33. Which of the following equipment can check the condition of a transistor?
    (a) Current tracer   (b) Ohmmeter
    (c) Digital display meter   (d) All of these

34. For what kind of amplifications can the active region of the common-emitter configuration be used?
    (a) Voltage   (b) Current
    (c) Power   (d) All of these

35. In which region are both the collector-base and base-emitter junctions forward-biased?
    (a) Active   (b) Cutoff
    (c) Saturation   (d) Non-saturation

36. Under normal conditions a diode conducts current when it is
    (a) Reverse-biased   (b) Forward-biased
    (c) Avalanched   (d) Saturated

37. An n-type semiconductor material
    (a) is intrinsic.   (b) has trivalent impurity atoms added.
    (c) has pentavalent impurity atoms added.   (d) requires no doping.

38. Effectively, how many valence electrons are there in each atom within a silicon crystal?
    (a) 2   (b) 4
    (c) 8   (d) 16

39. The boundary between p-type material and n-type material is called
    (a) a diode.   (b) a reverse-biased diode.
    (c) a pn junction.   (d) a forward-biased diode.

40. An SCR remains turned on if the anode current is more than the
    (a) Breakdown current   (b) Trigger current
    (c) Holding current   (d) Threshold current

41. FET has offset voltage of about
    (a) 0.2 V   (b) 0.9 V
    (c) 0.7 V   (d) 0 V

42. Which of the following transistor is affected by static electricity
    (a) npn Transistor   (b) JFET
    (c) UJT   (d) MOSFET

43. There is a small amount of current across the barrier of a reverse-biased diode. This current is called
    (a) Forward-bias current   (b) Reverse breakdown current
    (c) Conventional current   (d) Reverse leakage current

44. Analog signals can be converted into discrete-time signals by
    (a) Sampling   (b) Quantizing
    (c) Coding   (d) Multiplexing

45. $\delta(n)$ is equal to
    (a) u(n) + u(n-1)   (b) u(n) - u(n-1)
    (c) u(n) * u(n-1)   (d) u(n) + u(n-1) + u(n-2)

46. The fundamental period of a sinusoidal signal is
    (a) $\dfrac{2\pi}{\omega_0}$ (b) 2π

    (c) $2\pi\omega_0$ (d) $\dfrac{\omega_0}{2\pi}$

47. A signal is an energy signal if
    (a) $E = 0, P = 0$ (b) $E = \infty, P < \infty$
    (c) $E < \infty, P = 0$ (d) $E < \infty, P = \infty$

48. A system whose output depends on future inputs is a
    (a) Static system   (b) Dynamic system
    (c) Causal system   (d) Linear system

49. Fourier series applies to
    (a) Only periodic signals   (b) Only aperiodic signals
    (c) Both periodic and aperiodic signals   (d) Only Random signals

50. A signal $g(t) = A$ then $g(t)$ is a
    (a) Energy signal   (b) Power signal
    (c) Neither energy nor power signal   (d) Insufficient data

51. An impulse function consist of
    (a) pure dc   (b) pure ac
    (c) infinite bandwidth with linear phase variations   (d) entire frequency range with constant phase

52. The trigonometric Fourier series representation of an odd function consists of
    (a) Cosine term only   (b) Sine term only
    (c) Both Sine and Cosine term   (d) None

53. The frequency spectrum of a periodic signal is
    (a) Continuous   (b) Discrete
    (c) Both continuous and discrete   (d) None

54. The type of systems which are characterized by input and the output quantized at certain levels are called as
    (a) Discrete   (b) Analog
    (c) Continuous   (d) Digital

55. A system which is linear is said to obey the rules of
    (a) Scaling   (b) Additivity
   (c) Both scaling and additivity   (d) Homogeneity

56. A time invariant system is a system whose output
    (a) increases with a delay in input
    (b) decreases with a delay in input
    (c) remains same with a delay in input
    (d) vanishes with a delay in input

57. The frequency spectrum indicates
    (a) The relative phase of each frequency components
    (b) The relative magnitude of each frequency components
    (c) The relative frequency of each frequency components
    (d) None of these

58. For ditortionless transmission, the amplitude and phase responses are
    (a) Zero and Constant
    (b) Constant and Linear
    (c) Infinite and zero
    (d) Linear and zero

59. The cross correlation of $x_1(t)$ and $x_2(t)$ is the same as the convolution of
    (a) $x_1(t)$ and $x_2(-t)$
    (b) $x_1(t)$ and $x_2(t)$
    (c) $x_1(-t)$ and $x_2(t)$
    (d) $x_1(-t)$ and $x_2(-t)$

60. The initial value of $L^{-1}\left[\dfrac{5}{S(S+2)}\right]$ is
    (a) 0
    (b) 5
    (c) ∞
    (d) 5/2

61. The signal whose ROC is entire Z plane is
    (a) $\delta(n)$
    (b) u(n)
    (c) r(n)
    (d) a^n

62. The ROC of a stable system must include the
    (a) Origin
    (b) Infinity
    (c) A ring
    (d) Unit circle

63. Which of the following impulse response of LTI system represents a stable system?
    (a) $h(t) = e^t \cos tu(t)$
    (b) $h(t) = e^t \sin tu(t)$
    (c) $h(t) = e^{-t} \cos tu(t)$
    (d) $h(t) = t\sin tu(t)$

64. The differentiation of a unit impulse is,
    (a) Infinity
    (b) Zero
    (c) One
    (d) Two

65. Fourier transform of $\cos w_0 t$ is,
    (a) $X(\Omega - \Omega_0) + X(\Omega + \Omega_0)$
    (b) $\dfrac{1}{2}X(\Omega - \Omega_0) + \dfrac{1}{2}X(\Omega + \Omega_0)$
    (c) $\pi[\delta(\Omega - \Omega_0) + \delta(\Omega + \Omega_0)]$
    (d) $\dfrac{\pi}{2}[X(\Omega - \Omega_0) + X(\Omega + \Omega_0)]$

66. When determining Thevenin's resistance of a circuit
    (a) all sources must be open circuited
    (b) all sources must be short circuited
    (c) all voltage sources must be open circuited and all current sources must be short circuited
    (d) all sources must be replaced by their internal resistances

67. Three resistance of 15 W each are connected in delta. The resistance of equivalent star will have a value of

    (a) 7 W   (b) 5 W

    (c) 9 W   (d) 2 W

68. A DC voltage source is connected across a series R-L-C circuit. Under steady state conditions, the applied DC voltage drops entirely across the

    (a) R only   (b) L only

    (c) C only   (d) R and L combination

69. The condition for the validity of Ohm's law is that the

    (a) Temperature should be remain constant   (b) Current should be proportional to the voltage

    (c) Resistance must be wire wound type   (d) All of these

70. How are 500W resistors connected so as to give an effective resistance of 750W?

    (a) Three resistors of 500W each, in parallel

    (b) Three resistors of 500W each, in series

    (c) Two resistors of 500W each, in parallel

    (d) Two resistors of 500W each, in parallel and the combination in series with another 500W resistor

71. Two bulbs of 100W/ 250 V and 150W/250 V are connected in series across a supply of 250 V. The power consumed by the circuits is

    (a) 30 W   (b) 60 W

    (c) 100 W   (d) 250 W

72. A circuit having neither any energy source nor emf source is called

    (a) Unilateral circuit   (b) Bilateral circuit

    (c) Passive circuit   (d) Active circuit

73. Inductance has the dimensions of

    (a) Flux/current   (b) Flux/length

    (c) (Voltage)2/current   (d) None of these

74. A coil of inductance 2H and resistance 1W is connected to a 10 V battery with negligible internal resistance. The amount of energy stored in the magnetic field is

    (a) 8 J   (b) 50 J

    (c) 25 J   (d) 100 J

75. Which one of the following has the ability to act as an open circuit for dc and a short circuit for ac of high frequency?

    (a) An insulator   (b) A capacitor

    (c) A resistor   (d) None of these

76. The constant voltage source is

    (a) Active and bilateral   (b) Passive and bilateral

    (c) Active and unilateral   (d) Passive and unilateral

77. Ideal current source have

    (a) Zero internal resistance   (b) Infinite internal resistance

    (c) Low value of voltage   (d) Large value of current

78. In a circuit shown below, the voltage and current sources are ideal. The voltage (V_{out}) across the current source is
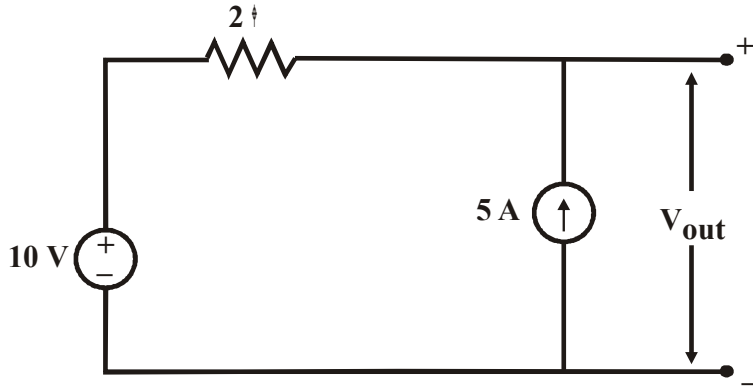
    (a) 0 V   (b) 5 V

    (c) 10 V   (d) 20 V

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

    (a) 4   (b) 5

    (c) 6   (d) 11

80. For any lumped network, for any cut sets and at any instant of time the algebraic sum of all branch currents traversing the cut-set branches is always

    (a) One   (b) Zero

    (c) Infinity   (d) Greater than zero, but less than one

81. What is the voltage across the current source for the below-shown circuit?
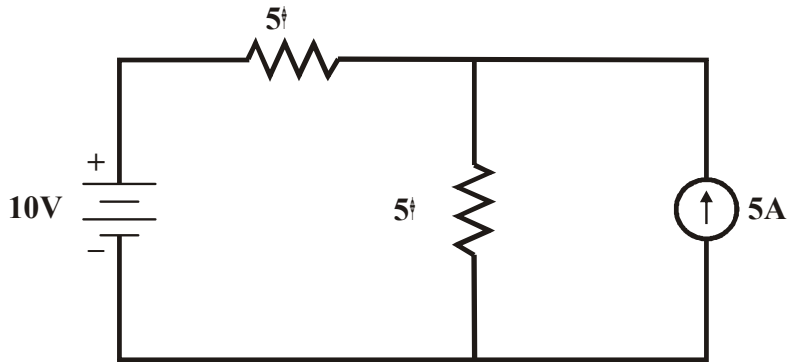
    (a) 5 V   (b) 7.5 V

    (c) 12.5 V   (d) 17.5 V

82. A 2-port network is represented by the following equation

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

The value of Z_{12} is

    (a) 3   (b) -3

    (c) 3/41   (d) 2/31

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

    (a) Thevenin's theorem   (b) Norton theorem

    (c) Tellegen theorem   (d) Superposition theorem

84. The low-frequency circuit impedance and the high-frequency circuit impedance for a series resonance circuit respectively are

    (a) Capacitive and inductive   (b) Inductive and capacitive

    (c) Resistive and inductive   (d) Capacitive and resistive

85. If the Q-factor of a coil at a resonant frequency of 1.5 MHz is 150 for a series resonant circuit, then the corresponding bandwidth is

    (a) 225 MHz   (b) 1.06 MHz

    (c) 50 KHz   (d) 10 KHz

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

    (a) $R = \sqrt{\dfrac{L}{C}}$ (b) $R = \sqrt{LC}$

    (c) $R = \sqrt{\dfrac{C}{L}}$ (d) $R = \dfrac{L}{C}$

87. In an intrinsic semiconductor, the Fermi level

    (a) Lies at the center of forbidden energy gap   (b) Is near the conduction band

    (c) Is near the valence band   (d) May be anywhere in the forbidden energy gap

88. The forbidden gap for germanium is

    (a) 7.2 eV   (b) 0.72 eV

    (c) 0.072 eV   (d) 72 eV

89. The process of adding impurities to a pure semiconductor is called

    (a) Mixing   (b) Doping

    (c) Diffusing   (d) All of these

90. n – type silicon is obtained by doping silicon with

    (a) Germanium   (b) Aluminum

    (c) Boron   (d) Phosphorus

91. Ferrites have

    (a) Low copper loss   (b) Low eddy current loss

    (c) Low resistivity   (d) High specific gravity compared to iron

92. Which material is used for making permanent magnet?

    (a) Carbon steel   (b) Germanium

    (c) Silicon   (d) None of these

93. In a network containing active components, the output voltage

    (a) Will always be greater than the input voltage

    (b) Will always be equal to the input voltage

    (c) Can be less than or greater than input voltage only

    (d) Will be less than, equal to or greater than the input voltage

94. The concentration of minority carriers in an extrinsic semiconductor under equilibrium is

    (a) Directly proportional to the doping concentration.

    (b) Inversely proportional to the doping concentration.

    (c) Directly proportional to the intrinsic concentration.

    (d) Inversely proportional to the intrinsic concentration.

95. In an intrinsic Semiconductor the free electron concentration depends on

    (a) Effective mass of electrons only

    (b) Effective mass of holes only

    (c) Temperature of the Semiconductor

    (d) Width of the forbidden energy hand of the semiconductor

96. Two Two-port networks are connected in cascade. The combination is to the represented as a single two – port network, by multiplying the individual

    (a) z-parameter matrices   (b) h-parameter matrices

    (c) y-parameter matrices   (d) ABCD parameter

97. What happens to the resistance of a conductor if its length is increased three times and diameter is halved?

    (a) Resistance remains the same   (b) Resistance is increased by 3 times

    (c) Resistance is increased by 6 times   (d) Resistance is increased by 12 times

98. A practical current source is represented by

    (a) A resistance in series with an ideal current source

    (b) A resistance in parallel with an ideal current source

    (c) A resistance in parallel with an ideal voltage source

    (d) A resistance in series with an ideal voltage source

99. How much is the base-to-emitter voltage of a transistor in the "on" state?

    (a) 0 V   (b) 0.7 V

    (c) 0.9 V   (d) 1.0 V

100. The Fourier series of an odd periodic function, contains only

    (a) odd harmonics   (b) even harmonics

    (c) cosine terms   (d) sine terms

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