

MIZORAM PUBLIC SERVICE COMMISSION

**TECHNICAL COMPETITIVE EXAMINATIONS FOR RECRUITMENT TO THE POST OF
INSPECTOR OF LEGAL METROLOGY
UNDER FOOD, CIVIL SUPPLIES & CONSUMER AFFAIRS, GOVT. OF MIZORAM
NOVEMBER, 2023**

ELECTRONICS & COMMUNICATION ENGINEERING

PAPER-I

Time Allowed : 2 hours

Full Marks : 200

All questions carry equal marks of 2 each.

Attempt all questions.

1. N-type semiconductor has
 - (a) Immobile negative donor ion
 - (b) Immobile positive donor ion
 - (c) Holes (majority carrier)
 - (d) No minority carrier
2. For n-type semiconductor, the doping material is
 - (a) Trivalent
 - (b) Bivalent
 - (c) Tetravalent
 - (d) Pentavalent
3. Which of the following gives piezo-electric effect?
 - (a) Mu metal
 - (b) PVDF
 - (c) Sapphire
 - (d) Ferrites
4. Temperature coefficient of resistance in a pure semiconductor is
 - (a) 0
 - (b) positive
 - (c) dependent on size of specimen
 - (d) negative
5. The forbidden energy gap for Ge is
 - (a) 0.72 eV
 - (b) 7.2 eV
 - (c) 72.0 eV
 - (d) 0.27 eV
6. The SI unit of resistance is
 - (a) Ampere
 - (b) Ohm-meter
 - (c) Coulomb
 - (d) Ohm
7. A given copper of $10\ \Omega$ resistance is stretched to double its original length, Its modified resistance will be
 - (a) $50\ \Omega$
 - (b) $70\ \Omega$
 - (c) $20\ \Omega$
 - (d) $40\ \Omega$
8. Effective Q of the equivalent electrical circuit of a quartz crystal is of the order of
 - (a) 2,00,000
 - (b) 3,00,000
 - (c) 4,00,000
 - (d) 5,00,000

9. The temperature coefficient of a thermistor
- (a) is positive
 - (b) is negative
 - (c) zero
 - (d) may be positive or negative depending on its composition
10. Which of the following helps in reducing the switching time of a transistor?
- (a) a resistor connected from base to ground
 - (b) a resistor connected from emitter to ground
 - (c) a capacitor connected from base to ground
 - (d) a capacitor connected from emitter to ground
11. The longest wavelength that can be absorbed by silicon, which has the bandgap of 1.12 eV is $1.1 \mu\text{m}$. If the longest wavelength that can be absorbed by another material is 0.87 μm , then the bandgap of this material is
- (a) 0.99 eV
 - (b) 1.42 eV
 - (c) 1.1 eV
 - (d) 2.3 eV
12. The intrinsic concentration in a semiconductor at 300°K is 10^{13} cm^{-3} . When it is doped with donor type impurities, the majority carrier concentration becomes 10^{17} cm^{-3} . What is the value of its minority carrier density?
- (a) $3 \times 10^{17} \text{ cm}^{-3}$
 - (b) 10^7 cm^{-3}
 - (c) 10^{12} cm^{-3}
 - (d) 10^9 cm^{-3}
13. Hall effect is useful for the measurement of a semiconductor's
- (a) Mobility, carrier, concentration and temperature
 - (b) Type (n-type or p-type), conductivity and temperature
 - (c) Type (n-type or p-type), mobility and carrier concentration
 - (d) Mobility, conductivity and temperature
14. What does the quality factor of a dielectric mean?
- (a) it is related to the value of the permittivity of the material
 - (b) it is related to the ratio between maximum stored energy and average power loss in the dielectric
 - (c) It is related to the breakdown voltage of the dielectric
 - (d) It is related to the resistivity of the material
15. In an n-type silicon crystal at room temperature, which of the following can have a concentration of $4 \times 10^{19} / \text{cm}^3$?
- (a) Silicon atoms
 - (b) Holes
 - (c) Dopant atoms
 - (d) Valence electrons
16. Which of the following material is not an insulator?
- (a) Graphite
 - (b) Lucite
 - (c) Bakelite
 - (d) Diamond
17. A piezoelectric crystal has Young's modulus of 130 GPa. The uniaxial stress that must be applied to increase its polarization from 550 to 555 C m^{-2} is nearly
- (a) 1.182 GPa
 - (b) 1.173 GPa
 - (c) 2.169 GPa
 - (d) 3.369 GPa
18. The resistivity of material is a function of temperature because
- (a) Electron density varies with temperature
 - (b) Electron gas density varies with temperature
 - (c) Amplitude of vibration of atom varies with temperature
 - (d) None of these

19. If three 15 μF capacitors are connected in series, the net capacitance is,
(a) 15 μF (b) 25 μF
(c) 35 μF (d) 5 μF
20. A dielectric material must be
(a) Semiconductor (b) Insulator
(c) Metal (d) Resistor
21. An electrolytic capacitor can be used for
(a) AC and DC (b) AC only
(c) DC only (d) None of these
22. Three capacitors each of the capacity C are given. The resultant capacity $2/3 C$ can be obtained by using them
(a) two are in series and third in parallel across this combination
(b) all are in parallel
(c) all are in series
(d) two are in parallel and third in series with this combination
23. Air capacitors are generally available in the range
(a) 10 to 400 pF (b) 100 to 120 pF
(c) 400 to 700 pF (d) 5 to 100 pF
24. Electric flux is a _____ field, and its density is a _____ field.
(a) Vector, Vector (b) Scalar, Scalar
(c) Vector, Scalar (d) Scalar, Vector
25. In an optical fiber, the refractive index of the cladding material should be,
(a) Nearly unity (b) Very low
(c) Less than that of the core (d) More than that of the core
26. Base to emitter voltage in forward biased transistor decreases with the increase of temperature at the following rate,
(a) 3.5 mV/degree C (b) 7.5 mV/degree C
(c) 2.5 mV/degree C (d) 0.5 mV/degree C
27. The input impedance of a transistor is _____ as compared to MOSFET.
(a) Very high (b) Equal
(c) High (d) Low
28. In a transistor _____.
(a) $I_E = I_C + I_B$ (b) $I_B = I_C + I_E$
(c) $I_E = I_C - I_B$ (d) $I_C = I_E + I_B$
29. Conventional flow of current in a pnp transistor is from
(a) Base to Emitter (b) Emitter to Base
(c) Base to collector (d) Collector to Base
30. In the active region of a transistor, collector-base junction is _____ biased.
(a) Forward, forward (b) Reverse, reverse
(c) Reverse, forward (d) Forward, reverse

31. A transistor's current gain of 0.99 in the CB mode. its current gain in the CC mode is,
(a) 33 (b) 66
(c) 50 (d) 100
32. A bipolar junction transistor has a common base forward short circuit current gain of 0.99. Its common emitter forward short circuit current gain will be
(a) 9 (b) 99
(c) 999 (d) 9999
33. For an NPN bipolar transistor, what is the mainstream of current in the base region?
(a) Diffusion of electrons (b) Diffusion of holes
(c) Drift of electrons (d) Drift of holes
34. As the Fermi energy of silver is 8.8×10^{-19} Joule, the velocity of the fastest electron in silver at 0°K (Given: Rest mass of electron = 9.1×10^{-31} kg) is
(a) 7×10^5 m/s (b) 7.22×10^7 m/s
(c) 1.39×10^6 m/s (d) 1.97×10^7 m/s
35. Which capacitor-store higher amount of energy?
(a) Air capacitor (b) Paper capacitor
(c) Mica capacitor (d) Plastic film capacitor
36. Assertion (A) : Helium, Argon and Neon are gaseous at room temperature.
Reason (R) : The atoms in Helium, Argon and Neon are chemically extremely inactive
(a) Both A and R are true and R is correct explanation of A
(b) Both A and R are true but R is not correct explanation of A
(c) A is true but R is false
(d) A is false but R is true
37. The minority carrier life time and diffusion constant in a semiconducting material are respectively $100 \mu\text{s}$ and $100 \text{ cm}^2/\text{s}$. The diffusion length of the carrier is
(a) 0.7 cm (b) 0.01 cm
(c) 0.0141 cm (d) 0.1 cm
38. Natural Group material are
(a) Quartz, Rochelle salt (b) $\text{LiSO}_4, \text{BaTiO}_3$
(c) $\text{LiSO}_4, \text{PbTiO}_3$ (d) Quartz, PbZrO_3
39. In fabrication Silicon BJT in ICs by epitaxial process, the number of diffusions used is usually
(a) 9 (b) 6
(c) 2 (d) 12
40. VMOS stands for:
(a) Voltage MOS (b) Vertical MOS
(c) Variable MOS (d) VLSI MOS
41. For normal SCR, turn ON time is (t_q is turn OFF time)
(a) $> t_q$ (b) $= \frac{t_q}{3}$
(c) $< t_q$ (d) $= \frac{t_q}{2}$

42. What range of resistor values would you get when checking a transistor for forward- and reverse-biased conditions by an ohmmeter?
- (a) $100\ \Omega$ to a few $k\ \Omega$, exceeding $100\ k\ \Omega$ (b) $1000\ \Omega$, exceeding $100\ k\ \Omega$
(c) $1\ \Omega$, exceeding $100\ k\ \Omega$ (d) $1\ K\ \Omega$ to a few $K\ \Omega$
43. Turn on time for an SCR is $10\ \mu s$. If an inductance is inserted in the anode circuit, the turn on time will be
- (a) $10\ \mu s$ (b) $< 10\ \mu s$
(c) $> 10\ \mu s$ (d) $20\ \mu s$
44. An SCR is turned off by
- (a) Reducing anode voltage to zero (b) Reverse bias the gate
(c) Removing gate signal (d) Forward bias condition
45. Which of the given device is the fastest switching device
- (a) BJT (b) SCR
(c) MOSFET (d) JFET
46. In the forward blocking mode of a silicon controlled rectifier, the SCR is
- (a) In natural state (b) In ON state
(c) In forward bias state (d) In OFF state
47. A silicon controlled rectifier is turned on if the anode current is greater than
- (a) Trigger current (b) Anode current
(c) Cathode current (d) Holding current
48. Which of the given device is the most suitable power device for a higher frequency (above $100\ kHz$) switching application
- (a) SCR (b) Power MOSFET
(c) GTO (d) BJT
49. _____ ICs are the most commonly used
- (a) Thin films (b) Monolithic
(c) Hybrid (d) Thin films and hybrids
50. An IC has _____ size.
- (a) Large (b) Very large
(c) Extremely large (d) Extremely small
51. Digital ICs process
- (a) Linear signals only (b) Digital signals only
(c) Both linear and digital signals (d) Continuous signals only
52. ICs are generally made of _____
- (a) Silicon (b) Copper
(c) Aluminum (d) GaAs
53. The active components in an IC are
- (a) Resistors and capacitors (b) Resistors and inductors
(c) Transistors and diodes (d) Capacitors and inductors
54. In CMOS logic circuit the n-MOS transistor acts as:
- (a) Not used in CMOS circuits (b) Load
(c) Pull up network (d) Pull down network

55. CMOS inverter has _____ regions of operation.
(a) Five (b) Nine
(c) Seven (d) Eleven
56. CMOS inverter has _____ output impedance.
(a) Extremely high (b) Very high
(c) High (d) Low
57. The maximum number of electrons in each shell of an atom is
(a) 7 (b) $2n^2$ where n is the number of the shell
(c) 9 (d) 2
58. Which one most appropriate dynamic system?
(a) $y(n) + y(n - 1) + y(n + 1)$ (b) $y(n) + y(n - 1)$
(c) $y(n) = x(n)$ (d) $y(n) + y(n - 1) + y(n + 3) = 0$
59. An energy signal has $G(f) = 10$. Its energy density spectrum is
(a) 1 (b) 10
(c) 100 (d) 1000
60. A voltage $V(t)$ is a Gaussian ergodic random process with a mean of zero and a variance of 4 volt². If it is measured by a dc meter. The reading will be
(a) 0 (b) 2
(c) 4 (d) 6
61. A first order system will never be able to give a _____ response.
i. band stop
ii. band pass
iii. all pass
- Choose the correct option
(a) i, ii, iii true (b) i and iii true, ii false
(c) i, ii are true, iii is false (d) i, ii are false, iii is true
62. If transfer function of a system is $H(z) = 6 + z^{-1} + z^{-2}$ then system is
(a) minimum phase (b) maximum phase
(c) mixed phase (d) mixed and minimum phases
63. The analog signal $m(t)$ is given below $m(t) = 4 \cos 100 \pi t + 8 \sin 200 \pi t + \cos 300 \pi t$, the Nyquist sampling rate will be
(a) 1/100 (b) 1/200
(c) 1/300 (d) 1/600
64. A voltage wave having 5% fifth harmonic content is applied to a series RC circuit. The percentage fifth harmonic content in the current wave will be
(a) 5% (b) more than 5%
(c) less than 5% (d) equal or more than 5%
65. The analog signal given below is sampled by 600 samples per second for $m(t) = 3 \sin 500 \pi t + 2 \sin 700 \pi t$ then folding frequency is
(a) 500 Hz (b) 400 Hz
(c) 300 Hz (d) 200 Hz

66. Two function $g_1(t)$ and $g_2(t)$ with correlation of 6 has average power of 4 and 5 respectively. The power of $g_1(t) + g_2(t)$ is
- (a) 14 (b) 21
(c) 27 (d) 33
67. Double integration of a unit step function would lead to
- (a) an impulse (b) a parabola
(c) a ramp (d) a doublet
68. The type of systems which are characterized by input and the output capable of taking any value in a particular set of values are called as,
- (a) discrete (b) digital
(c) analog (d) continuous
69. Should real time instruments like oscilloscopes be time invariant?
- (a) Yes (b) Sometimes
(c) Never (d) They have no relation with time variance
70. All real time systems concerned with the concept of causality are
- (a) non causal (b) causal
(c) neither causal nor non causal (d) memory less
71. If a signal $f(t)$ has energy E , the energy of the signal $f(2t)$ is equal to
- (a) E (b) $E/2$
(c) $2E$ (d) $4E$
72. Two of the angular frequencies at which its Fourier transform becomes zero are
- (a) $\pi, 2\pi$ (b) $0, 2\pi$
(c) $2\pi, 4\pi$ (d) $2\pi, 8\pi$
73. Fourier transform of a signal $h(t)$ is $H(j\omega) = (2 \cos \omega)(\sin 2\omega) / \omega$. The value of $h(0)$ is
- (a) 1 (b) $1/2$
(c) $1/4$ (d) $1/8$
74. Z-transform of e^{-t} sampled at 10 Hz will be,
- (a) $\frac{z}{z-100}$ (b) $\frac{z}{z-0.9}$
(c) $\frac{z}{z-9.9}$ (d) $\frac{z}{z-1.9}$
75. What is the set of all values of z for which $X(z)$ attains a finite value?
- (a) Radius of convergence (b) Radius of divergence
(c) Feasible solution (d) No solution
76. What is the ROC of z-transform of a two sided infinite sequence?
- (a) $|z| > r_1$ (b) $|z| < r_1$
(c) $r_2 < |z| < r_1$ (d) $|z| \geq r_1$
77. Find the Z-transform of $\delta(n+3)$
- (a) z (b) z^2
(c) z^3 (d) z^4

78. If $X(z)$ is $\frac{1}{1-z^{-1}}$ with $|z| > 1$, then what is the corresponding $x(n)$?

- (a) e^{-n}
- (b) e^n
- (c) $u(n)$
- (d) $u(n)e^{-n}$

79. Unit step response of the system described by difference equation $y(n) + y(n-1) = x(n)$ is

- (a) $\frac{z^2}{(z+1)(z-1)}$
- (b) $\frac{2z}{(z+1)(z-1)}$
- (c) $\frac{2(z+1)}{(z-1)}$
- (d) $\frac{z(z-1)}{2(z+1)}$

80. What is the z-transform of the signal $x[n] = \alpha^n u(n)$?

- (a) $X(z) = \frac{\alpha}{z-1}$
- (b) $X(z) = \frac{\alpha}{1-z}$
- (c) $X(z) = \frac{z}{z-\alpha}$
- (d) $X(z) = \frac{z-1}{z-\alpha}$

81. A network has 10 nodes and 17 branches. The number of different node pair voltage would be,

- (a) 25
- (b) 35
- (c) 45
- (d) 55

82. Consider the following:

Energy storage capability of basic passive elements is due to the fact that

- i. Resistance dissipates energy
- ii. Capacitance stores energy
- iii. Inductance dissipates energy

Which of the above is/are correct?

- (a) i, ii and iii
- (b) i and iii
- (c) iii alone
- (d) i and ii

83. $\sqrt{\frac{L}{C}}$ has the dimension of

- (a) Time
- (b) Capacitance
- (c) Inductance
- (d) Resistance

84. A 10Ω resistor, a 1H inductor and $1\mu\text{F}$ capacitor are connected in parallel. The combination is driven by a unit step current. Under the steady state condition, the source current flows through

- (a) the resistor
- (b) the inductor
- (c) the capacitor only
- (d) all the above

85. A source is delivering maximum power to a resistance through a network. The ratio of power delivered to the source power

- (a) is always 0.5
- (b) may be 0.5 or less
- (c) may be 0.5 or less or more
- (d) may be 0.5 or more

86. If an impedance Z_L is connected across a voltage source V with source impedance Z_S , then for maximum power transfer, the load impedance must be equal to,
- (a) source impedance Z_S
 - (b) complex conjugate of Z_S
 - (c) real part of Z_S
 - (d) imaginary part of Z_S
87. Consider a DC voltage source connected to a series R-C circuit. When the steady state reaches, the ratio of the energy stored in the capacitor to the total energy supplied by the voltage source, is equal to
- (a) 0.5
 - (b) 0.73
 - (c) 1.52
 - (d) 7.7
88. The superposition theorem is applicable to
- (a) Only current
 - (b) Only voltage
 - (c) Only power
 - (d) Current, Voltage and Power
89. The Superposition theorem requires as many circuits to be solved as there are
- (a) Sources
 - (b) Nodes
 - (c) Sources and nodes
 - (d) Sources, nodes and meshes
90. Millman's theorem yields
- (a) Equivalent voltage source only
 - (b) Equivalent current source only
 - (c) Equivalent voltage and current source
 - (d) Equivalent resistance
91. The dual pair of resistance is
- (a) Current
 - (b) Voltage
 - (c) Capacitance
 - (d) Conductance
92. Which one of the following theorems is a manifestation of the Law of conservation of Energy?
- (a) Norton's theorem
 - (b) Reciprocity theorem
 - (c) Tellegen's theorem
 - (d) Thevenin's theorem
93. The ratio of the current transform at one port to current transform at other port is called,
- (a) Current transfer ratio
 - (b) Voltage transfer ratio
 - (c) Transfer impedance
 - (d) Transfer admittance
94. The zeros in the transfer function are denoted by
- (a) 3
 - (b) 2
 - (c) 1
 - (d) 0
95. What is an ideal value of network function at poles?
- (a) Finite and non-zero
 - (b) Unity
 - (c) Zero
 - (d) Infinity
96. The time constant of an RC circuit is
- (a) RC
 - (b) $\frac{R}{C}$
 - (c) $\frac{1}{C} + \frac{1}{R}$
 - (d) $\frac{C}{R}$
97. An electrical network has an interconnection of _____ components
- (a) Electronics
 - (b) Electrical
 - (c) Mechanical
 - (d) Hydro

98. In a network, source is connected on _____ port.
- (a) Output
 - (b) Input
 - (c) Output and input
 - (d) Not connected
99. A transfer function of network analysis can be represented as _____.
- (a) Frequency
 - (b) Gain
 - (c) Attenuation
 - (d) Both (b) & (c)
100. Which of the following are active components used in network analysis?
- (a) Only switch
 - (b) Only hub
 - (c) Only router
 - (d) Switch, hub, router and stub
