

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

ELECTRICAL ENGINEERING PAPER-I

Time Allowed : 2 hours

Full Marks : 200

All questions carry equal marks of 2 each.

Attempt all questions.

- Two electric bulbs rated for the same voltage have powers of 200W and 100W. If their resistances are respectively R_1 and R_2 , then,
 - $R_1 = 2R_2$
 - $R_2 = 2R_1$
 - $R_2 = 4R_1$
 - $R_1 = 4R_2$
- What is the value of total electric flux coming out of a closed surface?
 - Zero
 - Equal to volume charge density
 - Equal to the total charge enclosed by the surface
 - Equal to the surface charge density
- The unit of $\nabla \times H$ is
 - Ampere
 - Ampere/meter
 - Ampere/meter²
 - Ampere-meter
- The magnitudes of the open-circuit and short circuit input impedances of a transmission line are $100\ \Omega$ and $25\ \Omega$ respectively. The characteristic impedance of the line is,
 - $25\ \Omega$
 - $50\ \Omega$
 - $75\ \Omega$
 - $100\ \Omega$
- The phase velocity of waves propagating in a hollow metal waveguide is
 - greater than the velocity of light in free space
 - less than the velocity of light in free space
 - equal to the velocity of light in free space
 - equal to the group velocity
- For an electromagnetic wave incident on a conducting medium, the depth of penetration
 - is directly proportional to the attenuation constant
 - is inversely proportional to the attenuation constant
 - has a logarithmic relationship with the attenuation constant
 - is independent of the attenuation constant
- When a particular mode is excited in a wave-guide, there appears an extra electric component in the direction of propagation. The resulting mode is
 - Transverse-electric
 - Transverse-magnetic
 - Longitudinal
 - Transverse-electromagnetic

8. Which one of the following sets of equations is independent in Maxwell's equations?
- (a) The two curl equations
 - (b) The two divergence equations
 - (c) Both the curl and divergence equations
 - (d) The two curl equations combined with the continuity equation
9. The electric field strength at any point equals
- (a) The potential gradient at that point
 - (b) Negative of the potential gradient at that point
 - (c) The charge at that point
 - (d) Negative of the charge at that point
10. Magnetic flux density B produced by a magnetic potential vector V_m is
- (a) $B = \nabla \cdot (\nabla \times V_m)$
 - (b) $B = \nabla \times V_m$
 - (c) $B = \nabla \cdot \nabla^2 / m$
 - (d) $B = \nabla \cdot \nabla_m$
11. In a perfect dielectric, wave propagation occurs
- (a) with zero attenuation
 - (b) with small attenuation
 - (c) with large attenuation
 - (d) with infinite attenuation
12. When the magnetic vector of an EM wave is parallel to the boundary surface and electric vector is parallel to the plane of incidence, the polarization is
- (a) Vertical
 - (b) Horizontal
 - (c) Elliptical
 - (d) Either (b) or (c)
13. Magnetic field strength due to current I at a distance r equals
- (a) $\frac{I}{4\pi r}$
 - (b) $\frac{I^2}{4\pi r}$
 - (c) $\frac{I}{2\pi r}$
 - (d) $\frac{I^2}{2\pi r}$
14. A dominant wave should have
- (a) No phase shift
 - (b) No attenuation
 - (c) Highest cutoff frequency
 - (d) Lowest cutoff frequency
15. The depth of penetration of a wave in a lossy dielectric increase with increasing
- (a) Conductivity
 - (b) Permeability
 - (c) Wavelength
 - (d) Permittivity
16. Characteristic wave impedance is
- (a) $\frac{E}{\mu}$
 - (b) $\sqrt{\frac{\epsilon}{\mu}}$
 - (c) $\sqrt{\frac{E_x}{H_y}}$
 - (d) $\frac{E_x}{H_y}$
17. Where two sinusoidally time varying vectors having different amplitudes and phases are added up, the resulting vector is
- (a) Linearly polarized
 - (b) Elliptically polarized
 - (c) Circularly polarized
 - (d) None of these

18. Poynting vector signifies

- (a) Power density vector producing electromagnetic field
- (b) Current density vector producing electromagnetic field
- (c) Power density vector producing electrostatic field
- (d) Current density vector producing electrostatic field

19. In a uniform plane wave, E and H are related as below

- (a) $\frac{E}{H} = \frac{\sqrt{\epsilon}}{\mu}$
- (b) $\frac{E}{H} = \frac{\sqrt{\mu}}{\epsilon}$
- (c) $\frac{E}{H} = 1$
- (d) $\frac{E}{H} = \frac{\epsilon}{\mu}$

20. If \bar{A} and \bar{J} are the vector potential and current density vectors associated with a coil, then $\int \bar{A} \cdot \bar{J} dV$ has the units of

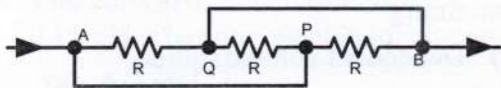
- (a) Flux-linkage
- (b) Power
- (c) Energy
- (d) Inductance

21. Two coaxial cables 1 and 2 are filled with different dielectric constants ϵ_{r1} and ϵ_{r2} respectively. The

ratio of the wavelengths in the two cables, $\left(\frac{\lambda_1}{\lambda_2}\right)$ is

- (a) $\sqrt{\frac{\epsilon_{r1}}{\epsilon_{r2}}}$
- (b) $\sqrt{\frac{\epsilon_{r2}}{\epsilon_{r1}}}$
- (c) $\frac{\epsilon_{r1}}{\epsilon_{r2}}$
- (d) $\frac{\epsilon_{r2}}{\epsilon_{r1}}$

22. Three equal resistors are connected as shown in Fig. 1. Find the equivalent resistance between points A and B



- (a) 3R
- (b) R/3
- (c) 3R/2
- (d) 2R/3

23. Five cells each of emf E and internal resistance r are connected in series. If due to oversight, one cell is connected wrongly, then equivalent emf and internal resistance of the combination are

- (a) 3E and 5r
- (b) 5E and 5r
- (c) 3E and 3r
- (d) 5E and 4r

24. The Cauer Form II of a reactive network synthesis is the successful removal of

- (a) Poles at infinity
- (b) Zeros at infinity
- (c) Poles at origin
- (d) Zeros at origin

25. For a two-port network to be reciprocal, it is necessary that

- (a) $z_{11} = z_{22}$ and $y_{21} = y_{12}$
- (b) $z_{11} = z_{22}$ and $AD - BC = 0$
- (c) $h_{11} = -h_{12}$ and $AD - BC = 0$
- (d) $y_{12} = y_{21}$ and $h_{21} = -h_{12}$

26. If two, two port networks are connected in parallel, then

- (a) z parameters are added
- (b) y parameters are added
- (c) ABCD parameters are multiplied
- (d) h parameters are added

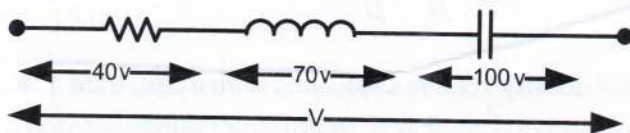
27. At half-power frequencies, the current in a series RLC circuit is

- (a) $\frac{1}{3}$ x current at resonance
- (b) $\frac{1}{\sqrt{2}}$ x current at resonance
- (c) $\frac{1}{\sqrt{3}}$ x current at resonance
- (d) $\frac{1}{2}$ x current at resonance

28. A 3H inductor has 2000 turns. How many turns must be added to increase the inductance to 5H?

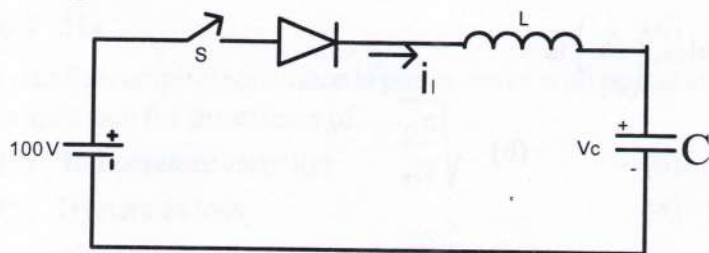
- (a) 1000 turns
- (b) 2500 turns
- (c) 2582 turns
- (d) 582 turns

29. The supply voltage |V| in diagram below is



- (a) 210V
- (b) 70V
- (c) 50V
- (d) 230V

30. In the circuit of Figure, the switch S is closed at $t=0$ with $i_L(0)=0$ and $V_C(0)=0$. In the steady state, V_C equals



- (a) 200V
- (b) 100V
- (c) 0V
- (d) -100V

31. Superposition theorem is not applicable to networks containing

- (a) Non linear elements
- (b) Dependent voltage source
- (c) Dependent current source
- (d) Transformer

32. Poles and zeros of a driving point function of a network are simple and interlace on the iw axis. The network consists of elements

- (a) R and C
- (b) L and C
- (c) R and L
- (d) R, L and C

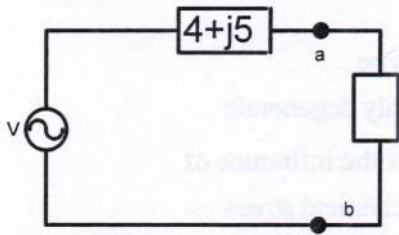
33. The network function $F(s) = \frac{s+2}{(s+1)(s+3)}$ represents an

- (a) RC impedance
- (b) RL impedance
- (c) RC impedance and an RL impedance
- (d) RC admittance and an RL impedance

34. Two coils having equal resistance but different inductances are connected in series. The time constant of the series combination is the

- (a) Sum of the time constants of the individual coils
- (b) Average of the time constants of individual coils
- (c) Geometric mean of the time constants of the individual coils
- (d) Product of the time constants of the individual coils

35. In the given circuit, maximum transfer to load Z_L takes place when Z_L equals



- (a) $(4 + j5)\Omega$ (b) $(4 - j5)\Omega$
 (c) $(5 + j4)\Omega$ (d) $(5 - j4)\Omega$
36. In a highly inductive circuit, a small capacitance is added in series. The angle between the applied voltage and resultant current will
 (a) Increase (b) Decrease
 (c) Remain absolutely unaltered (d) Alter insignificantly
37. A DC voltage V is applied at time $t=0$ to a series circuit consisting of resistor R and capacitor C . The current in the circuit at time t is
 (a) $\frac{V}{R}e^{-t/RC}$ (b) $\frac{V}{R}e^{t/RC}$
 (c) $\frac{V}{R}(1 - e^{-t/RC})$ (d) $\frac{V}{R}(1 - e^{t/RC})$
38. Which one of the following theorems is a manifestation of the law of conservation of energy?
 (a) Tellegen's theorem (b) Reciprocity theorem
 (c) Thevenin's theorem (d) Norton's theorem
39. If the resistance in a series RC circuit is increased, the magnitude of the phase
 (a) Increases (b) Remains the same
 (c) Decreases (d) Changes in an indeterminate manner
40. Two coils in differential connection have self induction of 2 mH and 4 mH and a mutual inductance of 0.15mH. The equivalent inductance of the combination is
 (a) 5.7 mH (b) 5.85 mH
 (c) 6 mH (d) 6.15 mH
41. In a delta connected polyphase circuit, the line current i_L is related to i_p
 (a) $i_L = \sqrt{3} i_p$ (b) $i_L = 3 i_p$
 (c) $i_L = \frac{1}{\sqrt{3}} i_p$ (d) $i_L = \frac{1}{3} i_p$
42. At $t=0^+$ with zero initial condition, which of the following acts as open circuit?
 (a) Inductor (b) Capacitor
 (c) Resistor (d) All of the above
43. The current through an inductance follows
 (a) A linear growth (b) A linear decay
 (c) An exponential decay (d) An exponential growth
44. Two electrical appliances are connected in parallel to a constant voltage supply. If current in one appliance is less than the second appliance by 1%, then power of the first appliance will be less by
 (a) 1 % (b) 2 %
 (c) 4 % (d) 5 %

45. When a semiconductor bar is heated at one end, a voltage across the bar is developed. If the heated end is positive, the semiconductor is
- (a) P-type (b) N-type
(c) Intrinsic (d) Highly degenerate
46. The Piezoelectric effect is the polarization of a dielectric under the influence of
- (a) Light (b) Mechanical stress
(c) Electrical stress (d) Heat
47. At very high temperatures, the mean free path and collision time in a conductor are proportional to
- (a) $1/T$ (b) $1/T^2$
(c) T^2 (d) Independent of T
- Where T is the temperature in deg. K.
48. A large value of the exchange interaction energy in a ferromagnetic material implies
- (a) Large saturation magnetization (b) High Curie temperature
(c) High melting point (d) Large diamagnetic susceptibility
49. Reluctivity is analogous to
- (a) Permeability (b) Conductivity
(c) Resistivity (d) Retentivity
50. Permanent dipole moment consists of the following angular momentum
- (a) Orbital angular momentum of electron (b) Electron spin angular momentum
(c) Nuclear spin angular momentum (d) All of them
51. A material with unequal anti-parallel atomic magnetic moments is
- (a) An anti-ferromagnet (b) ferrimagnet
(c) a ferrite (d) non-magnetic
52. As compared to Si, the electron mobility in GaAs is
- (a) Slower by about five times (b) Same
(c) Faster by about six times (d) Faster by about 200 times
53. The magnetization of a superconductor is
- (a) 0 (b) $-B$
(c) -1 (d) $-H$
54. In a dielectric, the power loss is proportional to
- (a) ω (b) ω^2
(c) $1/\omega$ (d) $1/\omega^2$
55. One heater coil boils certain amount of water in 10 minutes and another coil in 15 minutes. In how much time the same water will be boiled if the two heaters are put in series.
- (a) 12.5 min (b) 25 min
(c) 2.5 min (d) None of the above
56. The magnetic flux density in an air-cooled coil is 10^{-2} Wb/m². With a cast iron of relative permeability 100 inserted, the flux density will become
- (a) 10^{-4} Wb/m² (b) 10^4 Wb/m²
(c) 10^{-2} Wb/m² (d) 1 Wb/m²

57. A magnet is kept in air surrounded by an iron ring. The magnetic lines of force from the magnet will be
(a) Crowded in the ring (b) Crowded in air
(c) Evenly distributed (d) None of the above
58. A uniform electric field and a uniform magnetic field are produced, pointed in the same direction. An electron is projected with its velocity pointed in the same direction
(a) the electron will turn to its right (b) the electron will turn to its left
(c) the electron velocity will increase (d) the electron velocity will decrease
59. Two long straight parallel conductors, 10cm apart, carry currents 5 A each in opposite directions. Then the magnetic flux density at appoint mid-way between them is
(a) Zero (b) $10^{-5}T$
(c) $4 \times 10^{-5} T$ (d) None of the above
60. Fringing effect is ignored in a magnetic circuit if air-gap is
(a) Large (b) Small
(c) Very large (d) None of the above
61. A resistor and an inductor are connected in series to 220V AC supply. When measured with AC voltmeter, the potential difference across the resistor is 132V. The potential difference across the inductor is,
(a) 88V (b) 176V
(c) 352V (d) Cannot be predicted
62. Three delta connected resistors absorb 60 kW when connected to a 3-phase line. If the resistors are connected in star, the power absorbed is
(a) 60 kW (b) 20 kW
(c) 40 kW (d) 180 kW
63. If a balanced delta load has an impedance of $(6+j9)$ ohms per phase, then, impedance of each phase of equivalent star load is
(a) $(6+j9)$ ohm (b) $(2+j3)$ ohm
(c) $(12+j18)$ ohm (d) $(3+j4.5)$ ohm
64. In RLC series resonant circuit $R=16 \Omega$; $L=20mH$ and $C=0.01 \mu F$. If the applied voltage is 4V, voltage V_L across inductor is
(a) 312.5 V (b) 225.6 V
(c) 115.4 V (d) 353.5 V
65. The resistivity of a material is $2 \times 10^{-8} \Omega m$. what will be the resistance of a hollow pipe of the material of length 1m and having inner and outer radii 10 cm and 20 cm respectively?
(a) $2 \times 10^{-4} \Omega$ (b) $2.1 \times 10^{-7} \Omega$
(c) $3 \times 10^{-5} \Omega$ (d) $2.82 \times 10^{-3} \Omega$
66. The instrument in which springs provide the controlling torque as well as serve to lead current into and out of the operating coil is _____ instruments.
(a) Moving iron (b) Hot wire
(c) Permanent magnet moving coil (d) None of the above
67. If a wattmeter connected in circuit gives down scale reading, then we normally change connections of
(a) Current coil (b) Potential coil
(c) Both current and potential coils (d) None of the above

68. A 50V range voltmeter has a sensitivity of $20 \text{ k}\Omega/\text{V}$. The total resistance of the voltmeter is
- (a) $2.5 \text{ k}\Omega$ (b) $0.4 \text{ k}\Omega$
(c) $10 \text{ k}\Omega$ (d) $1 \text{ M}\Omega$
69. A single phase energy meter has a constant load current of 4 A passing through it for 5 hours at unity power factor. If the meter makes 1140 revolutions during this period, the meter constant is
- (a) 480 rev/kWh (b) 240 rev/kWh
(c) 320 rev/kWh (d) 960 rev/kWh
70. The sensitivity of a moving coil galvanometer is 60 divisions/ampere. When a shunt is used, the sensitivity becomes 10 divisions/ampere. If the galvanometer resistance is 20Ω , the value of shunt is
- (a) 15Ω (b) 20Ω
(c) 4Ω (d) 5Ω
71. In a potentiometer experiment, it is found that no current flows through the galvanometer when the terminals of the cell are connected across 52 cm of potentiometer wire. If the cell is shunted by a resistance of 5Ω , the balance point is found at 40 cm of the wire from the same end. The internal resistance of the cell is
- (a) 1.5Ω (b) 2.5Ω
(c) 3Ω (d) 4.5Ω
72. A small swamping resistance is put in series with operating coil of a moving coil ammeter in order to compensate for the effects of
- (a) Temperature variation (b) External magnetic fields
(c) Hysteresis loss (d) None of the above
73. Fermi level in a p-type semiconductor lies close to
- (a) The top of the valance band (b) The bottom of the valance band
(c) The top of the conduction band (d) The bottom of the conduction band
74. Which one of the following materials can not be used for permanent magnets?
- (a) Alnico (b) Barium ferrite
(c) Carbon steel (d) Iron cobalt alloy
75. For which one of the following materials, is the hall coefficient zero?
- (a) Metal (b) Insulator
(c) Intrinsic semiconductor (d) Alloy
76. Superconductivity is destroyed
- (a) At high temperature (b) At high magnetic field
(c) In presence of magnetic impurities (d) In all the above cases
77. For an insulating material, dielectric strength and dielectric loss should be respectively
- (a) High and high (b) Low and high
(c) High and low (d) Low and low
78. With increase in temperature, magnetic susceptibility of a ferromagnetic material will
- (a) Increase (b) Decrease
(c) Increase initially and then decrease (d) Remain constant

79. The hysteresis loop for the material of the core of a transformer should be
- (a) Short and narrow
 - (b) Tall and narrow
 - (c) Short and wide
 - (d) Tall and wide
80. By inserting a slab of dielectric material between the plates of a parallel plate capacitor, the energy stored in the capacitor has increased three times. The dielectric constant of the material is
- (a) 9
 - (b) 3
 - (c) 1/3
 - (d) 1/9
81. The resistance of a metallic wire would
- (a) Increase as the operating frequency increases.
 - (b) Decrease as the operating frequency increases
 - (c) Remain unaffected on increasing the operating frequency
 - (d) Initially increase upto a certain value of the operating frequency and then decrease with increase in operating frequency.
82. An intrinsic semiconductor at a temperature of absolute zero behaves like an insulator because of
- (a) Non-availability of free electrons
 - (b) Non-recombination of electronics with holes
 - (c) Low drift velocity of free electrons
 - (d) Low (almost zero) electron energy
83. An air gap provided in the iron core of an inductor prevents
- (a) Flux leakage
 - (b) Hysteresis loss
 - (c) Core saturation
 - (d) Heat generation
84. The magnetic permeability is maximum for
- (a) Paramagnetic materials
 - (b) Ferromagnetic materials
 - (c) Diamagnetic materials
 - (d) None of the above
85. In eddy current damping, disc or former I made of a material that is a
- (a) Conductor but non-magnetic
 - (b) Conductor but magnetic
 - (c) Non-conductor and non-magnetic
 - (d) Non-conductor but magnetic
86. The instrument whose deflection is given by the expression $\theta \propto I^2 \cdot \frac{dM}{d\theta}$ is known as
- (a) Electro-dynamic type
 - (b) Repulsive type
 - (c) Electrostatic type
 - (d) Attraction type
87. A 12 bit A/D converter has a range 0-10 V. What is the approximate resolution of the converter?
- (a) 1 mV
 - (b) 2.5 mV
 - (c) 2.5 μ V
 - (d) 12 mV
88. A resistance strain gauge is fastened to a beam subjected to a strain of 1×10^6 yielding a resistance change of 240 mW. If the original resistance of the strain gauge is 120 W, the gauge factor would be
- (a) 5
 - (b) 2
 - (c) 1
 - (d) 0.2
89. Maxiwell's inductance-capacitance bridge is used for measurement of inductance of
- (a) Low Q coils only
 - (b) Medium Q coils only
 - (c) High Q coils only
 - (d) Low and medium Q coils
90. What is the range for a $3\frac{1}{2}$ digital meter?
- (a) 0 to 1999
 - (b) 0 to 1500
 - (c) 0 to 999
 - (d) 0 to 19999

91. A set of independent current measurements taken by four observers was recorded as: 117.02 mA, 117.11 mA, 117.08 mA and 117.03 mA. What is the range of error?
- (a) ± 0.045 (b) ± 0.054
(c) ± 0.065 (d) ± 0.056
92. Thermistors are essentially semiconductors
- (a) Well suited to precision measurement of temperature
(b) Widely used in the lower temperature range of -100°C to 300°C
(c) Which behave as resistors with a high negative temperature coefficient of resistance
(d) All of the above
93. The scale of a voltmeter is uniform. Its type is
- (a) Moving iron (b) Induction
(c) Moving coil permanent magnet (d) Moving coil dynamometer
94. A torque/weight ratio of an instrument indicates
- (a) Selectivity (b) Accuracy
(c) Fidelity (d) Sensitivity
95. The purpose of applying post deflection potential is
- (a) to increase deflection sensitivity (b) to speed up the electrons
(c) to increase the brightness of the spot (d) to keep deflection angle unchanged.
96. In AC circuits, the connection of measuring instruments cause loading errors which may effect
- (a) Only the magnitude of quantity being measured
(b) Only the phase of the quantity being measured
(c) Both the magnitude and phase of the quantity being measured
(d) Magnitude, phase and also the waveform of the quantity
97. In distortion factor meter, the filter is used to suppress
- (a) DC component (b) Odd harmonics
(c) Even harmonics (d) Fundamentals
98. In a LVDT, the two secondary voltages
- (a) are independent on the core position (b) vary unequally depending on the core position
(c) vary equally depending on the core position (d) are always in phase quadrature
99. Which meter has the highest accuracy
- (a) PMMC (b) Moving Iron
(c) Electrodynamometer (d) Rectifier
100. A signal of 10mV at 75 MHz is to be measured. Which of the following instrument can be used?
- (a) VTVM (b) Cathode ray oscilloscope
(c) Moving iron voltmeter (d) Digital multimeter.

* * * * *