

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

ELECTRICAL ENGINEERING

PAPER - I

Time Allowed : 2 hours

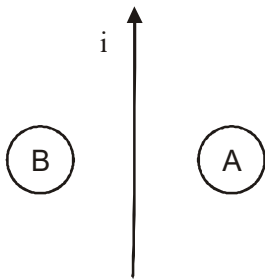
Full Marks : 200

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

- The electric field in the vicinity of two oppositely charged parallel conductors is
 - radial uniformly
 - in parallel lines between the two imaginary parallel planes passing through the centres of the two conductors
 - not uniform and its direction changes from point to point
 - in parallel circular paths between the two conductors, with the centre of the circles located at the mid-point of a line joining the two centres of the two conductors
- 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
- Which one of the following statements is correct? The wavelength of a wave propagating in a waveguide is
 - smaller than the free space wavelength
 - greater than the free space wavelength
 - directly proportional to the group velocity
 - inversely proportional to the phase velocity
- The Maxwell equation $\nabla \times H = J + \frac{\partial \bar{D}}{\partial t}$ is based on
 - Ampere's law
 - Gauss's law
 - Faraday's law
 - Coulomb's law
- The ratio of the velocity of a wave in free-space to that in the conducting medium is known as
 - space factor
 - attenuation
 - pointing vector
 - refractive index
- If frequency of a plane electromagnetic wave increases four times the depth of penetration, when the wave is incident normally on a good conductor will
 - increase by factor of two
 - decrease by a factor of four
 - remain same
 - decrease by a factor of two

7. The electric field of a uniform plane wave is given by
 $E = 10 \sin(10\omega t - \pi z) \hat{a}_x + 10 \cos(\omega t - \pi z) \hat{a}_y$ (V / m). The polarization of the wave is
- (a) Circular (b) Elliptical
(c) Linear (d) Undefined
8. The important postulate arising out of Maxwell's modification of Ampere's law is that
- (a) a steady current produces a magnetic field
(b) a changing magnetic field produces an electric field
(c) a changing electric field produces a magnetic field
(d) a motional emf is produced by a coil moving in a magnetic field
9. For an electromagnetic wave incident from one medium on to a second medium, total reflection takes place when the angle of incidence is equal to the
- (a) Brewster angle with E field perpendicular to the plane of incidence
(b) Brewster angle with E field parallel to the plane of incidence
(c) Critical angle with the wave moving from the denser medium to a rarer medium
(d) Critical angle with the wave moving from the a rarer medium to a denser medium
10. A medium behaves like dielectric when the
- (a) displacement current is just equal to the conduction current
(b) displacement current is less than the conduction current
(c) displacement current is much greater than the conduction current
(d) displacement current is almost Negligible
11. A plane slab of dielectric having dielectric constant 5, placed normal to a uniform field with a flux density of 2 C/m², is uniformly polarized. The polarization of the slab is
- (a) 0.4 C/m² (b) 1.6 C/m²
(c) 2.0 C/m² (d) 6.4 C/m²
12. An electric field on a plane is described by its potential $V=20(r^{-1} + r^{-2})$ where r is the distance from the source. The field is due to
- (a) a monopole (b) a dipole
(c) both a monopole and a dipole (d) a quadrupole
13. The equation of continuity defines the relation between
- (a) electric field and magnetic field (b) electric field and charge density
(c) flux density and charge density (d) current density and charge density
14. A uniform plane wave has a wavelength of 2 cm in free space and 1 cm in a perfect dielectric. What is the relative permittivity of the dielectric?
- (a) 2.0 (b) 0.5
(c) 4.0 (d) 0.25
15. A lossless transmission line with characteristic impedance of 600 ohms is terminated in a purely resistive load of 900 ohms. The reflection coefficient is
- (a) 0.2 (b) 0.5
(c) 0.667 (d) 1.5

16. When electric field is parallel to the plane of incidence, the electromagnetic wave is said to be
(a) linearly polarized (b) circularly polarized
(c) elliptically polarized (d) parallel polarized
17. The electric field strength of a charge
(a) increases with distance (b) decreases with distance
(c) decreases with square of distance (d) decreases with cube of distance
18. In a good conductor the phase relation between the tangential components of electric field E_t and the magnetic field H_t is:
(a) E_t and H_t are in phase (b) E_t and H_t are out of phase
(c) H_t leads E_t by 90° (d) E_t leads H_t by 45°
19. A straight current carrying conductor and two conducting loops A and B are shown in the figure given below. What are the induced currents in the two loops?

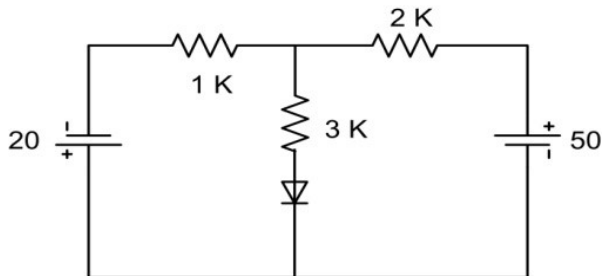


- (a) anticlockwise in A and clockwise in B (b) clockwise in A and anticlockwise in B
(c) clockwise both in A and B (d) anticlockwise both in A and B
20. Fields are said to be circularly polarized if their magnitudes are
(a) equal and they are in phase (b) equal and they differ in phase by $\pm 90^\circ$
(c) unequal and they differ in phase by $\pm 90^\circ$ (d) unequal and they are in phase
21. Maxwell's wave equations are
(a) $\nabla \times E = \frac{-\partial B}{\partial t}$ (b) $\nabla \times E = \frac{-\partial B}{\partial t}$, $\nabla \times H = \frac{-\partial D}{\partial t}$
(c) $\nabla \cdot D = 0$, $\nabla^2 E = \mu_0 \epsilon_0 \frac{\partial^2 E}{\partial t^2}$ (d) $\nabla^2 E = \mu_0 \epsilon_0 \frac{\partial^2 E}{\partial t^2}$, $\nabla^2 B = \mu_0 \epsilon_0 \frac{\partial^2 B}{\partial t^2}$
22. When a time varying field is applied to a circuit with a capacitor
(a) current in the circuit consists of conduction current and displacement current
(b) displacement current passes through the capacitor
(c) conduction current is equal to the displacement current
(d) conduction current density is J and displacement current density is $\frac{\partial D}{\partial t}$
23. If \vec{E} is the electric intensity, $\nabla(\nabla \times \vec{E})$ is equal to
(a) \vec{E} (b) $|\vec{E}|$
(c) null vector (d) zero

24. Total number of electrons that can be accommodated in various electron states in a valence band of a given solid is equal to
- (a) atomic number of the solid
 - (b) half the number of atoms in the solid
 - (c) the number of atoms in the solid
 - (d) twice the number of atoms in the solid
25. Which of the following is zero as applied to electromagnetic fields?
- (a) $\text{grad div } \vec{A}$
 - (b) $\text{div grad } V$
 - (c) $\text{div curl } \vec{A}$
 - (d) $\text{curl curl } \vec{A}$
26. 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
27. Some ceramic superconductors become superconducting
- (a) Below liquid helium temperature
 - (b) Between liquid helium and liquid nitrogen temperatures
 - (c) Above liquid nitrogen temperature but below room temperature
 - (d) Above room temperature
28. The Hall effect voltage in intrinsic silicon is
- (a) positive
 - (b) zero
 - (c) negative
 - (d) changes in sign on application of magnetic field
29. Ferrites have
- (a) Low copper loss
 - (b) Low eddy current loss
 - (c) Low resistivity
 - (d) High specific gravity compared to iron
30. Which type of magnetic behaviour is observed in a type-1 super conductor?
- (a) perfect diamagnetism
 - (b) perfect paramagnetism
 - (c) perfect ferromagnetism
 - (d) perfect ferrimagnetism
31. Which one of the following statements is correct? The hall coefficient of an intrinsic semiconductor is
- (a) positive
 - (b) negative
 - (c) zero
 - (d) infinite
32. The conductivity of a conducting material on being subject to critical magnetic field changes to
- (a) normal state
 - (b) unstable state
 - (c) temperature-independent state
 - (d) temperature-dependent state
33. Superconductivity is destroyed
- (a) At high temperature
 - (b) At high magnetic field
 - (c) In presence of magnetic impurities
 - (d) In all the above cases
34. For a semiconductor, which one of the following statements is NOT correct?
- (a) When an electron and hole recombine, energy must be liberated
 - (b) Electrons in the conduction band can acquire a net acceleration from a field because there are empty energy levels available
 - (c) An electron in the valence band cannot be accelerated by the field unless there are empty energy levels available
 - (d) Holes cannot be accelerated by the field unless there are empty energy levels available

35. On which of the following factors does the value of critical current density in a superconductor depend?
(a) Temperature (b) Applied magnetic field
(c) Temperature and applied magnetic field (d) Silsbee's rule
36. All magnetic materials lose their magnetic properties when
(a) Cooled to low temperature (b) Heated to high temperature
(c) Kept in an aluminium box (d) Kept in vacuum
37. At the increasing temperature, the electrical conductivity would
(a) increase in metals as well as in intrinsic semiconductors
(b) increase in metals but decrease in intrinsic semiconductors
(c) increase in metals but decrease in intrinsic semiconductors
(d) decrease in metals as well as in intrinsic semiconductors
38. The temperature coefficient of a resistance of a doped semiconductor is
(a) always positive
(b) always negative
(c) zero
(d) positive or negative depending on the level of doping
39. Principle of Hall Effect is used in the construction of which of the following?
(a) Ammeter (b) Voltmeter
(c) Galvanometer (d) Gaussmeter
40. The electron relaxation time of metal A is 2.7×10^{-4} sec and that of B is 1.35×10^{-4} sec. The ratio of resistivity of B to resistivity of A will be
(a) 4.0 (b) 2.0
(c) 0.5 (d) 0.25
41. When the temperature of a magnetic material is raised above the Curie point, it becomes
(a) diamagnetic (b) paramagnetic
(c) ferromagnetic (d) ferromagnetic
42. Which one of the following is not permanent magnetic material?
(a) Chromium steel (b) Silicon iron
(c) Cobalt steel (d) Alnico
43. Which one of the following materials does not have a covalent bond?
(a) Metals (b) Silicon
(c) Organic polymers (d) Diamond
44. Piezoelectric effect is generally observed in
(a) insulators (b) insulators and semiconductors
(c) conductors and superconductors (d) conductors and semiconductors
45. Ferrites are the materials which have
(a) low permeability and low dielectric loss (b) low permeability and high dielectric loss
(c) high permeability and low dielectric loss (d) high permeability and high dielectric loss
46. With an increase in temperature, the Fermi level in an intrinsic semiconductor
(a) moves closer to the conduction band edge (b) moves closer to the valence band edge
(c) moves into the conduction band (d) remains at the centre of the forbidden gap

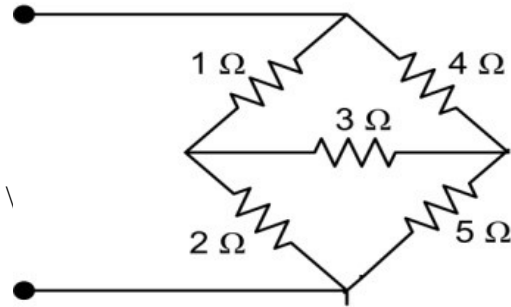
47. Ferrimagnetic materials generally find application as
(a) conductors (b) insulators
(c) superconductors (d) semiconductors
48. In intrinsic semiconductor the free electron concentration depends on
(a) effective mass of electrons only
(b) effective mass of holes only
(c) temperature of the semiconductor
(d) width of the forbidden energy band of the conductor
49. Thermal expansion of materials arises for
(a) strong bonds (b) weak bonds
(c) thermal vibrations (d) asymmetry of potential energy curve
50. The temperature coefficient of resistance of an insulator is
(a) positive and independent of temperature (b) negative and independent of temperature
(c) negative and dependant on temperature (d) positive and dependent on temperature
51. A semiconductor has a band gap of 2 eV. The wavelength of radiation emitted from the semiconductor when electrons and holes recombine is
(a) 625 nm (b) 625 mm
(c) 625 μ m (d) 625 cm
52. When two-wattmeter method of measurement of power is used to measure power in a balanced three phase circuit; if the wattmeter reading is zero, then
(a) power consumed in the circuit is zero (b) power factor of the circuit is zero
(c) power factor is unity (d) power factor is 0.5
53. For the parallel RLC circuit to be overdamped
(a) $R < 2\sqrt{\frac{L}{C}}$ (b) $R > 2\sqrt{\frac{L}{C}}$
(c) $R < \frac{1}{2}\sqrt{\frac{L}{C}}$ (d) $R > \frac{1}{2}\sqrt{\frac{L}{C}}$
54. The Thevenin resistance across the diode in the circuit is



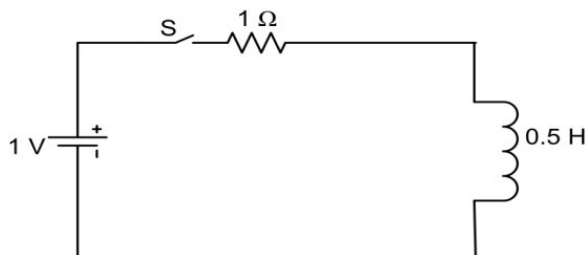
- (a) $2\frac{3}{4}K$ (b) $2\frac{1}{5}K$
(c) $3\frac{2}{3}K$ (d) $3K$

55. According to maximum power transfer theorem, when is the maximum power absorbed by one network from another network?
- (a) The impedance of one of the network is half that of the other
 - (b) The impedance of one is the complex conjugate of the other
 - (c) The impedance of one is equal to that of the other
 - (d) Only the resistive parts of both are equal

56. The input resistance of the circuit shown is



- (a) 1Ω
 - (b) 3.36Ω
 - (c) 2.24Ω
 - (d) 1.12Ω
57. The poles and zeros of an all-pass network are located in which part of the s-plane?
- (a) Poles and zeros are in the right half of s-plane
 - (b) Poles and zeros are in the left half of s-plane
 - (c) Poles in the right half and zeros in the left half of s-plane
 - (d) Poles in the left half and zeros in the right half of s-plane
58. In a network containing resistance and reactances, the roots of the characteristics equation given for the circuit?
- (a) The forced response
 - (b) The total response
 - (c) The natural response
 - (d) The damped response
59. Which of the following is incorrect with regard to reciprocity theorem.
- (a) applicable for single voltage source
 - (b) initial conditions are assumed to be zero
 - (c) there should not be any extra dependent or independent sources in network
 - (d) none of these
60. Cauer and Foster forms of realizations are used only for
- (a) driving point reactance functions
 - (b) transfer reactance functions
 - (c) driving point impedance functions
 - (d) transfer impedance functions
61. Steady state value of the current in the circuit



- (a) 0
- (b) $1/2$
- (c) 2
- (d) 1

62. The maximum power that a 12 V d.c. source with an internal resistance of $2\ \Omega$ can supply to a resistive load is
- (a) 12 W (b) 18 W
(c) 36 W (d) 48 W
63. When network are connected in series, it is convenient to use
- (a) Z-parameter (b) Y-parameter
(c) h-parameter (d) g-parameter
64. For a series RLC circuit, the power factor at the lowest half power frequency is
- (a) 0.5 lagging (b) 0.5 leading
(c) unity (d) 0.707 leading
65. A series RLC circuit resonance at 1 MHz at frequency of 1.1 MHz the circuit impedance is
- (a) capacitive (b) inductive
(c) resistive (d) none of these
66. The condition for the electrical symmetry in the network is
- (a) $h_{12} = -h_{21}$ (b) $AD - BC = 1$
(c) $Z_{12} = Z_{21}$ (d) $A = D$
67. 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 theorem (b) Norton theorem
(c) Tellegen theorem (d) Superposition theorem
68. In a series RLC circuit, the maximum voltage across the capacitor occurs at a frequency
- (a) double the resonant frequency (b) equal to resonant frequency
(c) times the resonant frequency (d) below the resonant frequency
69. In a two port network, the condition for reciprocity in terms of h-parameters is
- (a) $h_{12} = h_{21}$ (b) $h_{11} = h_{22}$
(c) $h_{11} = -h_{22}$ (d) $h_{12} = -h_{21}$
70. The driving point impedance function $Z(s) = \frac{s^2 + 2s + 2}{s^2 + s + 1}$ can be realized as a
- (a) R-C network (b) R-L network
(c) L-C network (d) R-L-C network
71. Three currents i_1 , i_2 and i_3 are approaching a node. If $i_1 = 10 \sin(400t + 60^\circ)$ A, and $i_2 = 10 \sin(400t - 60^\circ)$ A, then i_3 is
- (a) 0 (b) $10 \sin(400t)$ A
(c) $-10 \sin(400t)$ A (d) $-5\sqrt{3} (3 \sin(400t))$ A
72. The number of independent KVL and KCL equations for a network with n-nodes and l links are respectively
- (a) l and n (b) l and n-1
(c) n-1 and l (d) n and l-1
73. A pole of driving point admittance function implies
- (a) zero current for a finite value of driving voltage
(b) zero voltage for a finite value of driving current

- (c) an open circuit condition
- (d) None of (a), (b) and (c) mentioned in the question

74. For an ideal step-down ($n:1$) transformer, which one of the following is the ABCD parameter matrix?

(a) $\begin{bmatrix} n & 1 \\ 1 & n \end{bmatrix}$

(b) $\begin{bmatrix} n & 0 \\ 0 & n \end{bmatrix}$

(c) $\begin{bmatrix} n & 0 \\ 0 & \frac{1}{n} \end{bmatrix}$

(d) $\begin{bmatrix} n & \frac{1}{n} \\ \frac{1}{n} & 1 \end{bmatrix}$

75. In a digital voltmeter, the oscillator frequency is 400 kHz and the ramp voltage falls from 8 V to 0 V in 20 msec. The number of pulses counted by the counter is

- (a) 800
- (b) 2000
- (c) 4000
- (d) 8000

76. In calibration of a dynamometer wattmeter by potentiometer, phantom loading arrangement is used because

- (a) the arrangement gives accurate results
- (b) the power consumed in calibration work is minimum
- (c) the method gives quick results
- (d) the onsite calibration is possible

77. Rectifier moving coil instruments respond to

- (a) peak value, irrespective of the nature of the waveform
- (b) average value, for all waveforms
- (c) rms value for all waveforms
- (d) rms value, for symmetrical square waveforms

78. Galvanometer type recorders use

- (a) vibration galvanometer
- (b) ballistic galvanometer
- (c) D'Arsonval galvanometer
- (d) tangent galvanometer

79. Which one of the following has the highest accuracy?

- (a) Standard resistance
- (b) Standard inductance
- (c) Standard capacitance
- (d) Standard mutual inductance

80. A 10 bit A/D converter is used to digitise an analog signal in the 0 to 5 range. The maximum peak to peak ripple voltage that can be allowed in the DC voltage is

- (a) nearly 100 mV
- (b) nearly 50 mV
- (c) nearly 25 mV
- (d) nearly 5.0 mV

81. In a permanent magnet moving coil instrument, if the control spring is replaced by another one having a higher spring constant, then the natural frequency and damping ratio will

- (a) decrease
- (b) increase and decrease respectively
- (c) decrease and increase respectively
- (d) increase

82. The moving coil in a dynamometer wattmeter is connected

- (a) in series with the fixed coil
- (b) across the supply

- (c) in series with the load (d) across the load
83. The capacitance and loss angle of a given capacitor specimen are best measured by
(a) Wheatstone bridge (b) Maxwell bridge
(c) Anderson bridge (d) Schering bridge
84. The battery cells in an electronic multimeter are required to measure which one of the following?
(a) Resistance (b) Voltage
(c) Current (d) Power
85. The accuracy of Kelvin's double bridge for the measurement of low resistance is high because the bridge
(a) use two pairs of resistance arms
(b) has medium value resistance in the ratio arms
(c) uses a low resistance link between standard and test resistances
(d) uses a null indicating galvanometer
86. Which of the following transducers is classified as an active transducer?
(a) Metallic strain gauge (b) Capacitive microphone
(c) LVDT (d) Piezoelectric transducer
87. The correct sequence of the blocks in an analog data acquisition unit starting from the input is
(a) Transducer-Recorder-Signal Conditioner (b) Transducer-Signal Conditioner-Recorder
(c) Signal Conditioner-Transducer-Recorder (d) Signal Conditioner-Recorder-Transducer
88. Which one of the following digital voltmeters is most suitable to eliminate the effect of period noise?
(a) Ramp type digital voltmeter
(b) Integrating type digital voltmeter
(c) Successive approximation type digital voltmeter
(d) Servo type digital voltmeter
89. What one of the following decides the time of response of an indicating instrument?
(a) Deflecting system (b) Controlling system
(c) Damping system (d) Pivot and Jewel bearing
90. A successive approximation A/D converter has a resolution of 20 mV. What is its digital output for an analog input of 2.17V?
(a) 01101100 (b) 01101101
(c) 01101011 (d) 01110100
91. A Wheatstone bridge requires a change of 6 ohms in the unknown arm of the bridge to produce a change in deflection of 3 mm of the galvanometer. The sensitivity of the instrument is
(a) 0.5 percent (b) 2.0 percent
(c) 0.5 mm/ohm (d) 2.0 ohm/mm
92. The bridge suitable for the measurement of an unknown inductance in terms of a known capacitance would include
(a) Maxwell and Hay (b) Maxwell and Scherring
(c) Hays and Scherring (d) Maxwell, Hay and Scherring
93. Which amplifier is used in an electronic multimeter?
(a) Power amplifier (b) Buffer amplifier

- (c) Differential amplifier (d) Wideband amplifier
94. Which one of the following is used for the measurement of 3-phase power factor?
(a) Power factor meter (b) Crossed-coil power factor meter
(c) Phase-angle watt hour meter (d) Polarised-vane power factor meter
95. In a dual slope integrating type digital voltmeter the first integration is carried out for 10 periods of the supply frequency of 50 Hz. If the reference voltage used is 2 V the total conversion time for an input of 1 V is
(a) 0.01 sec (b) 0.05 sec
(c) 0.1 sec (d) 1 sec
96. Measurement of flow, thermal conductivity and liquid level using thermistors make use of
(a) resistance decrease with temperature (b) resistance increase with temperature
(c) self-heating phenomenon (d) change of resistivity
97. A single channel digital storage oscilloscope uses a 12 bit, 10^8 samples ADC. For a 10 kHz sine wave input, what is the number of samples taken per cycle of input?
(a) 10^{12} (b) 10^8
(c) 10^4 (d) 10^2
98. In a single-phase power factor meter, the controlling torque is
(a) provided by spring control (b) provided by gravity control
(c) provided by stiffness of suspension (d) not required
99. For increasing the range of voltmeter, connect a
(a) high value resistance in series with voltmeter
(b) low value resistance in series with voltmeter
(c) high value resistance in parallel with voltmeter
(d) low value resistance in parallel with voltmeter
100. Which one of the following decides the precision of integrating digital voltmeter?
(a) Reference voltage of analog comparator (b) Slope of the generated ramp
(c) Width of the generated pulses (d) Electronic counter

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