

MIZORAM PUBLIC SERVICE COMMISSION
TECHNICAL COMPETITIVE EXAMINATIONS FOR
JUNIOR GRADE OF MIZORAM ENGINEERING SERVICE (AE/SDO)
UNDER PUBLIC HEALTH ENGINEERING DEPARTMENT,
GOVERNMENT OF MIZORAM, JANUARY-2024

ELECTRICAL ENGINEERING
PAPER-I

Time Allowed : 3 hours

FM : 200

SECTION - A (Multiple Choice questions) (100 Marks)

All questions carry equal mark of 2 each. Attempt all questions.

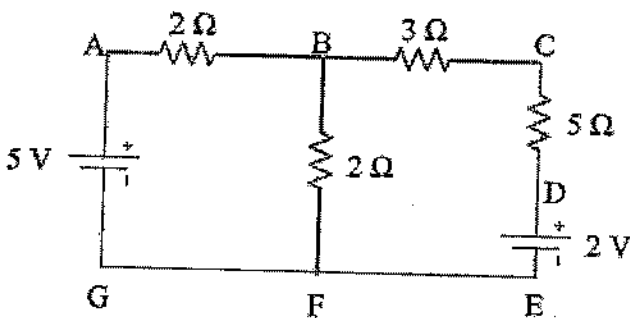
This Section should be answered only on the OMR Response Sheet provided.

1. An electromagnetic wave of frequency 3 MHz passes from vacuum into a dielectric medium with permittivity $\epsilon = 4$. Then,
 - (a) wavelength and frequency both remain unchanged.
 - (b) waveform is doubled and the frequency remains unchanged.
 - (c) wavelength is doubled and the frequency becomes half.
 - (d) wavelength is halved and the frequency remains unchanged.
2. 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
3. Which of the following represents the Maxwell's continuity equation for time varying electromagnetic fields
 - (a) $\nabla \cdot \vec{J} + \frac{\partial \rho}{\partial t} = 0$
 - (b) $\nabla \cdot \vec{J} - \frac{\partial \rho}{\partial t} = 0$
 - (c) $\nabla \cdot \vec{J} = \frac{\partial \rho}{\partial t}$
 - (d) None of these
4. When a lossless transmission line is terminated by a resistance equal to surge impedance, then what is value of the reflection coefficient?
 - (a) 1
 - (b) -1
 - (c) 0
 - (d) 0.5
5. When an EM wave is incident from a more dense medium to less dense medium at an angle equal to or exceeding the critical angle, the wave suffers
 - (a) total internal transmission
 - (b) total internal reflection
 - (c) total internal refraction
 - (d) none of these

6. When the relative permeability of a material is slightly less than 1, it is called a
 - (a) Diamagnetic material
 - (b) Paramagnetic material
 - (c) Ferromagnetic material
 - (d) None of these
7. In ferro-electric material, as the applied electric field is gradually reduced to zero, the residual polarization is known as
 - (a) coercive polarization
 - (b) remanent polarization
 - (c) electronic polarization
 - (d) hysteresis polarization
8. The effect of doping intrinsic semiconductor is to
 - (a) move the Fermi level away from the centre of the forbidden band
 - (b) move the Fermi level towards the centre of the forbidden band
 - (c) change the crystal structure of the semiconductor
 - (d) keep the Fermi level at the middle of the forbidden band
9. A superconducting material when placed in a magnetic field will
 - (a) not influence the magnetic field
 - (b) repel all the magnetic lines of force passing through it
 - (c) attract the magnetic field towards its centre
 - (d) attract the magnetic field but transfer it into a concentrated zone
10. A wire conductor of resistance 1Ω is doubled in length. Its resistance becomes
 - (a) the same as that when cold
 - (b) higher than cold resistance
 - (c) lower than cold resistance
 - (d) higher or lower than the cold resistance depending on the supply frequency
11. When two 2-port network are connected in parallel, it is convenient to use
 - (a) z-parameters
 - (b) y-parameters
 - (c) h-parameters
 - (d) inverse-h parameters
12. The Q factor of a series RLC circuit increase if
 - (a) R increases
 - (b) R decreases
 - (c) applied voltage increases
 - (d) current decreases
13. 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
14. In a series RLC circuit, the value of current at resonance is affected by the value of
 - (a) only L
 - (b) only C
 - (c) both L and C
 - (d) only R
15. A two-port network is symmetrical if
 - (a) $Z_{21} = Z_{12}$
 - (b) $AD - BC = 1$
 - (c) $Z_{11} = Z_{22}$
 - (d) $h_{12} = -h_{21}$

16. In a network made up of linear resistors and ideal voltage sources, values of all resistors are doubled. Then the voltage across each resistor is
- (a) doubled
 - (b) halved
 - (c) decreased four times
 - (d) not changes
17. 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
18. The purpose of choke in a fluorescent tube is
- (a) to decrease the current
 - (b) to increase the current
 - (c) to decrease the voltage momentarily
 - (d) to increase the voltage momentarily
19. Essential requirement of an electrical measuring instrument is that
- (a) its resistance should be low
 - (b) it is always connected in series in the circuit
 - (c) its introduction into the circuit under measurement does not alter the circuit conditions and the power consumed by it for its operation is small
 - (d) its resistance should be infinite
20. Inductance is measured in terms of capacitance and resistance by using
- (a) Schering bridge
 - (b) Anderson bridge
 - (c) Maxwell-Wien bridge
 - (d) Wien bridge
21. Strain gauge LVDT and thermocouple may be classified as
- (a) Active transducers
 - (b) Analogue transducers
 - (c) Primary transducers
 - (d) None of the above
22. The deflection of hot wire instrument depends on
- (a) RMS value of alternating current
 - (b) Voltage
 - (c) Average value of AC current
 - (d) Instantaneous value of AC current
23. If a dynamometer type wattmeter is connected in an AC circuit, the power indicated by the wattmeter will be
- (a) volt-ampere product
 - (b) average power
 - (c) peak power
 - (d) instantaneous power
24. 'Creep' in energy meters can be prevented by
- (a) using extra turns on the voltage coil
 - (b) having two holes on opposite sides of the disc
 - (c) using a stronger brake magnet
 - (d) using steel laminations of high permeability
25. An integrating digital voltmeter measures
- (a) true average value
 - (b) rms value
 - (c) peak value
 - (d) peak to peak value
26. Which statement is not applicable to the Coulomb's law?
- (a) The force between the two charged particles is along the line joining them.
 - (b) The force between them is directly proportional to the product of two charges.
 - (c) The force between them is directly proportional to the product of their masses.
 - (d) The force between them is inversely proportional to the square of the distance between them.

27. Which is the correct statement related to the Gauss's law?
- (a) The electric force between two charge particles is proportional to the product of the charges on two particles.
 - (b) The total electric flux through any closed surface is equal to the total charge enclosed by that surface.
 - (c) The electric field intensity is the force per unit charge in free space.
 - (d) The electric flux density is the measure of electric field intensity.
28. Resistance of a conductor is
- (a) directly proportional to the conductivity of the conductor
 - (b) directly proportional to the resistivity of the conductor
 - (c) directly proportional to the cross sectional area of the conductor
 - (d) inversely proportional to the length of the conductor
29. Which one is not a Maxwell's equation for static electromagnetic fields?
- (a) $\nabla \cdot D = \rho_v$
 - (b) $\nabla \cdot B = J$
 - (c) $\nabla \times E = 0$
 - (d) $\nabla \times H = J$
30. Two identical coaxial coils carry the same current I but in opposite directions. The magnitude of the magnetic field B at a point on the axis midway between the coils is
- (a) same as that produced by one coil
 - (b) twice that produced by one coil
 - (c) half that produced by one coil
 - (d) zero
31. On a B-H curve, initially B increases as H increases and gets saturation, after that as H decreases B decreases but does not follows the previous path. This phenomenon is called
- (a) Harmonics
 - (b) Saturation
 - (c) Magnetization
 - (d) Hysteresis
32. The resistance of a wire of uniform diameter d and length l is R . What will be the resistance of the wire of same material having the diameter and length half of the previous resistance?
- (a) $R/4$
 - (b) $R/2$
 - (c) R
 - (d) $2R$
33. The superposition theorem is applied when the circuit contains
- (a) a single voltage source
 - (b) a single current source
 - (c) a number of voltage or current sources
 - (d) a number of voltage sources only
34. How many junction points are there in the circuit shown below?



- (a) 2
- (b) 3
- (c) 4
- (d) 7

35. How much electrical energy is consumed in operation of a 20 W bulb 5 hours per day in a month of 30 days?
- (a) 2 kWh (b) 3 kWh
(c) 4 kWh (d) 5 kWh
36. A constant voltage is applied between the ends of a thin metallic wire. Some heat is developed in it. If both length and radius of the wire are halved, the heat developed during the same duration will become
- (a) half (b) twice
(c) one fourth (d) same
37. The electric lines of force enter or leave a charged surface at an angle
- (a) depending upon surface condition (b) 30°
(c) 60° (d) 90°
38. The potential at a point due to a charge is 9 V. If the distance from the charge is increased 3 times, the potential at that point will be
- (a) 3 V (b) 9 V
(c) 18 V (d) 27 V
39. When the relative permeability of a material is much greater than 1, it is called
- (a) diamagnetic material (b) paramagnetic material
(c) ferromagnetic material (d) none of these
40. An AC voltage of magnitude 20 V is applied to a circuit consisting of a resistor and an inductive coil with a negligible resistance. If the voltage across resistor is 12 V, the voltage across the coil is
- (a) 6 V (b) 8 V
(c) 10 V (d) 16 V
41. Moving iron instrument can be used for
- (a) DC work only (b) AC work only
(c) both DC and AC work (d) none of these
42. Which one is an integrating type measuring instrument?
- (a) Ammeter (b) Voltmeter
(c) Wattmeter (d) watt-hour meter
43. At what temperature does the resistivity of mercury completely disappear?
- (a) 4.2°K (b) 12.5°K
(c) 22.2°K (d) 55.2°K
44. The phenomenon by which a material in an external magnetic field becomes magnetized and remain magnetized for that time period is called
- (a) diamagnetism (b) ferromagnetism
(c) paramagnetism (d) ferrimagnetism
45. Which of the following magnetic materials have small area of hysteresis loop?
- (a) Saturable magnetic material (b) Soft magnetic material
(c) Hard magnetic material (d) Diamagnetic material
46. The breakdown voltage of air at normal temperature and pressure is
- (a) 20 kV/cm (b) 30 kV/cm
(c) 60 kV/cm (d) 90 kV/cm

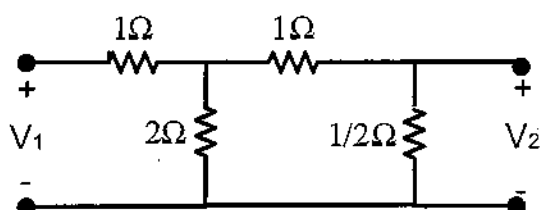
47. Which parameter represents the relationship between output current and output voltage in a two-port network?
- (a) Z – Parameter (b) Y – Parameter
(c) H – Parameter (d) G – Parameter
48. The charge carrier available in a semiconductor material
- (a) free electron and holes (b) free electrons only
(c) holes only (d) positively charged ions
49. In a homogeneous p-n junction semiconductor
- (a) the width of p and n layers are equal and constant throughout
(b) the impurity levels on both sides of the junctions are same
(c) same semiconductor materials is used on both sides of the junction
(d) different semiconductor materials are used on both sides of the junction
50. At a temperature zero Kelvin, silicon material behaves as
- (a) superconductor (b) conductor
(c) insulator (d) semiconductor

SECTION - B (Short answer type question) (100 Marks)

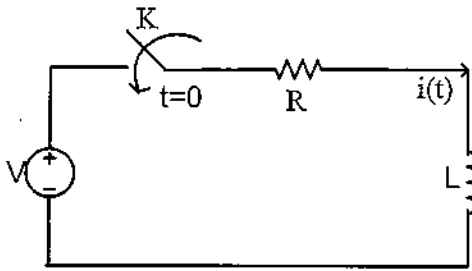
All questions carry equal marks of 5 each.

This Section should be answered only on the Answer Sheet provided.

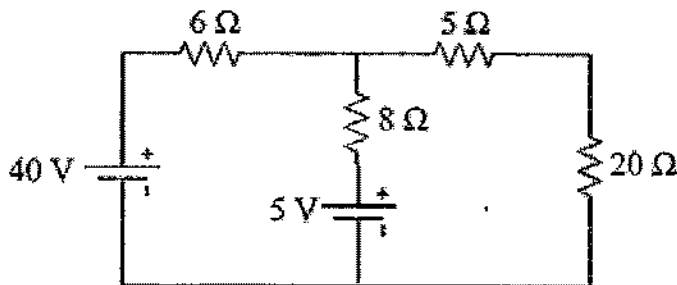
1. What is the importance of controlling torque in indicating instruments? When is indicating instrument said to be dead-beat? (3.5+1.5=5)
2. Briefly explain the different sources of errors in measurement.
3. Explain the force transducer with neat block diagram.
4. Explain deflecting, control and damping torques.
5. Physically explain the concept of divergence and curl of a vector.
6. State and briefly explain Gauss's law.
7. Distinguish between metals, insulators and semiconductors on the basis of band theory.
8. State the properties of conducting materials.
9. Explain briefly hysteresis loop with neat sketch.
10. The phase voltage and current of a star connected load is 100 V and 10 A. The power factor of the load is 0.8 (lag). Assuming that the system is 3 wire, 3-phase and power is measured by two wattmeters, find the readings of the wattmeters.
11. Determine the y-parameters for the resistive network shown in figure.



12. For the network shown in figure, find the transient current $i(t)$ for $t \geq 0$, when the switch 'K' is closed at $t=0$.



13. State Biot-Savart's and Ampere circuit laws.
14. Write the classification of magnetic materials and define them briefly.
15. A 15 W light bulb is supplied by a 12 V battery. Calculate the number of electrons passing through a cross-section of the filament in one hour.
16. Considering 20Ω as a load resistance, find the Thevenin's equivalent circuit of the circuit diagram shown in figure below.



17. Calculate the active and reactive components of current in each phase of a star connected 11 kV, three-phase generator supplying 5 MW at a lagging power factor of 0.8. Calculate the new power output, if the current is maintained at the same value but the power factor is raised to 0.9 lagging.
18. Write the differences between permanent magnet moving coil and moving iron type instruments.
19. What are the torques experienced on an indicator of a dynamometer type wattmeter? How these torques are important to the instrument?
20. Find the Z-parameters of the two-port network shown in the figure.

