

MIZORAM PUBLIC SERVICE COMMISSION

TECHNICAL COMPETITIVE EXAMINATIONS FOR JUNIOR GRADE OF MIZORAM ENGINEERING SERVICE, P&E CADRE (ELECTRICAL WING) UNDER POWER & ELECTRICITY DEPARTMENT, GOVERNMENT OF MIZORAM, JULY-2023

ELECTRICAL ENGINEERING PAPER-I

Time Allowed : 3 hours

FM : 200

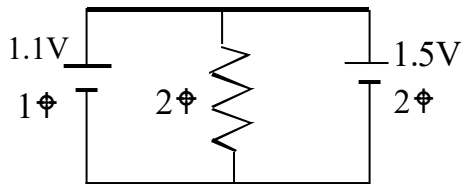
SECTION - A (Multiple Choice questions) (100 Marks)

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

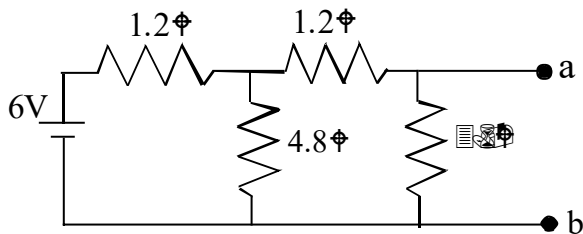
*This Section should be answered only on the **OMR Response Sheet** provided.*

- In practice, Earth is chosen as a place of zero electric potential because it
 - is non-conducting
 - is easily available
 - keep loosing and gaining electric charge every day
 - has almost constant potential
- In a charged conductor the charge resides in the
 - inner surface
 - outer surface
 - centre
 - none of these
- The work done in moving a positive charge q on an equipotential surface is
 - negative
 - zero
 - positive
 - positive infinite
- Electrons remain bonded to the nucleus due to which of the following forces
 - electrostatic
 - Vander Waal
 - gravitational
 - nuclear
- On rotating a point charge, having charge ' q ' around a charge ' Q ' in a circle of radius ' r ', the work done will be
 - q^2pr
 - q^2pQ/r
 - zero
 - $Q/2\epsilon_0 r$
- If the magnetic moment of a substance is zero, the substance is
 - diamagnetic
 - paramagnetic
 - ferromagnetic
 - anti-ferromagnetic
- A uniform plane electromagnetic wave incident normally on a plane surface of a dielectric material is reflected with a voltage standing wave ratio (VSWR) of 3. What is the percentage of incident power that is reflected?
 - 10%
 - 25%
 - 50%
 - 75%

8. A capacitor with no initial charge at $t = \infty$ acts as
(a) short circuit (b) open circuit
(c) current source (d) voltage source
9. In series LCR circuit, at resonance,
(a) current is maximum, power factor is zero (b) current is maximum, power factor is unity
(c) current is minimum, power factor is unity (d) none of these
10. An ideal voltage source
(a) has terminal voltage in proportion to current
(b) has terminal voltage in proportion to load
(c) has zero internal resistance
(d) has open circuit voltage nearly equal to the voltage of full load
11. The superposition theorem requires as many circuits to be solved as there are
(a) sources (b) nodes
(c) source + nodes (d) source + nodes + meshes
12. The current flowing in 2Ω resistor is

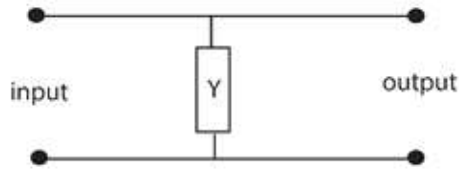


- (a) 0.2A (b) 0.35A
(c) 0.46A (d) 0.6A
13. The transient currents are due to
(a) voltage applied to the circuit
(b) resistance of the circuit
(c) impedance of the circuit
(d) changes in stored energy in inductors and capacitance
14. The resistance across terminals 'a' and 'b' in the circuit shown will be



- (a) 1.35Ω (b) 2.45Ω
(c) 6Ω (d) 10.8Ω

15. The transfer matrix of the network shown below will be



(a) $\begin{vmatrix} 1 & 0 \\ Y & 1 \end{vmatrix}$

(b) $\begin{vmatrix} 0 & 1 \\ Y & 0 \end{vmatrix}$

(c) $\begin{vmatrix} 1 & 1 \\ 0 & Y \end{vmatrix}$

(d) $\begin{vmatrix} 1 & Y \\ 0 & 1 \end{vmatrix}$

16. When a source is delivering maximum power to a load, the efficiency of the circuit

- (a) is always 50%
- (b) depends on the circuit parameters
- (c) is always 75%
- (d) is always 100%

17. The nature of atomic bond found in diamond is

- (a) ionic
- (b) covalent
- (c) metallic
- (d) all of these

18. In ferromagnetic materials, the spin moments associated with two sets of atoms are aligned

- (a) antiparallel to each other
- (b) parallel to each other
- (c) random to each other
- (d) antiparallel but of unequal magnitude

19. The relative permeability of paramagnetic material is

- (a) less than unity
- (b) equal to unity
- (c) greater than unity
- (d) none of these

20. The change in dimensions during the process of magnetisation is called

- (a) skin effect
- (b) Hall's effect
- (c) magnetostriction
- (d) none of these

21. The impurity atoms in semiconductors

- (a) reduce the energy gap
- (b) increase the kinetic energy of valence electrons
- (c) eject more charge carriers
- (d) all of these

22. In the semiconductor, the movement of holes is due to

- (a) movement of holes in the conduction band
- (b) movement of electrons in conduction band
- (c) movement of electrons in valence band
- (d) movement of holes in valence band

23. Hall's effect can be used to measure

- (a) electric field intensity
- (b) magnetic field intensity
- (c) carrier concentration
- (d) permeability

24. Ceramic loses its insulating properties above a temperature called

- (a) melting point
- (b) solidification point
- (c) curie point
- (d) flash point

25. Moving coil permanent magnet instruments can be used on

- (a) a.c and d.c
- (b) a.c only
- (c) d.c only
- (d) half wave rectified a.c

26. Wattmeter measures
- (a) apparent power
 - (b) true power
 - (c) volt ampere
 - (d) volt ampere reactive
27. Which of the following devices can not be used to measure pressure?
- (a) LVDT
 - (b) Strain gauge
 - (c) Pyrometer
 - (d) Pirani gauge
28. What type of bridge circuit is used to measure inductance and capacitance?
- (a) Wheatstone bridge
 - (b) D-C bridge
 - (c) A-C bridge
 - (d) A-C, D-C bridge
29. Frequency can be measured by using
- (a) Maxwell's bridge
 - (b) Schering bridge
 - (c) Heaviside Campbell bridge
 - (d) Wien's bridge
30. A transducer converts
- (a) mechanical energy into electrical energy
 - (b) mechanical displacement into electrical signal
 - (c) one form of energy into another form of energy
 - (d) electrical energy into mechanical form
31. A series RLC circuit consisting of $R=10$ ohms, $X_L=20$ ohms and $X_C=20$ ohms is connected across an AC supply of 100 V (rms). The magnitude and phase angle (with reference to supply voltage) of the voltage across the inductive coil are respectively
- (a) 100 V, 90°
 - (b) 100 V, -90°
 - (c) 200 V, 90°
 - (d) 200 V, -90°
32. Two incandescent light bulbs of 40 W and 60 W rating are connected in series across the mains. Then
- (a) bulbs together consume 100 W
 - (b) bulbs together consume 50 W
 - (c) 60 W bulb glows brighter
 - (d) 40 W bulb glows brighter.
33. A battery charger can drive a current of 5A into a 1Ω resistance connected at its output terminals. If it is able to charge an ideal 2 V battery at 7 A rate, then its Thevenin's equivalent will be
- (a) 7.5 V in series with 0.5Ω
 - (b) 12.5 V in series with 1.5Ω
 - (c) 7.5 V in parallel with 0.5Ω
 - (d) 12.5 V in parallel with 1.5Ω
34. A load that has a resistance of 10Ω to be connected to a supply that has a constant voltage of 120 Volts. If it is desired that the current to the load be varied from 3 to 5 amperes, what are the resistance and the current rating of the series rheostat that permit this variation?
- (a) $30\Omega, 5A$
 - (b) $10\Omega, 10A$
 - (c) $20\Omega, 10A$
 - (d) $20\Omega, 10A$
35. Three equal resistance of 5Ω are connected in delta. What is the resistance in one of the arms of the equivalent star circuit?
- (a) 5Ω
 - (b) 1.67Ω
 - (c) 10Ω
 - (d) 15Ω
36. A conductor of length 1 m moves at right angles to a magnetic field of flux density 1 Wb/m^2 with a velocity of 20 m/s. The induced emf in conductor will be
- (a) 100 V
 - (b) 20 V
 - (c) 2 V
 - (d) 40 V

37. Second Cauer's form of reactive network synthesis is the successful removal of
- (a) Poles at infinity (b) Zeros at infinity
(c) Poles at origin (d) Zeros at origin
38. Potential energy we stored in a system of 'n' point charge equals
- (a) $\frac{1}{2} \sum_{i=1}^n Q_i V_i$ (b) $\frac{1}{2} \sum_{i=1}^n Q_i$
(c) $\frac{1}{2} \sum_{i=1}^n Q_i V_i^2$ (d) $\frac{1}{2} \sum_{i=1}^n Q_i \sqrt{V_i}$
39. The ratio of tangential component of electric field at the surface of a conductor and the linear current density which flows as a result of this field is
- (a) characteristic impedance (b) surface impedance
(c) critical impedance (d) electromagnetic link impedance
40. Which one following statements does not pertain to the equation $\nabla \cdot B = 0$?
- (a) magnetic field is perpendicular to the electric field
(b) there are no sinks and sources for magnetic fields
(c) single magnetic pole cannot exist
(d) B is solenoidal.
41. Two electric dipoles aligned paralleled to each other and having the same axis exert a force F on each other, when a distance d apart. If the dipoles are at distance 2d apart, then the mutual force between them would be
- (a) $\frac{F}{2}$ (b) $\frac{F}{4}$
(c) $\frac{F}{8}$ (d) $\frac{F}{16}$
42. Force 'F' experienced by a test charge 'q' moving with velocity 'V' in magnetic field of intensity 'B' is given by
- (a) $F = q(V \times B)$ (b) $F = V \times BI_v I_B$
(c) $F = \frac{V \times B}{q} I_v I_B$ (d) $F = \frac{B^2}{q} I_B$
43. The dynamic characteristics of capacitive transducer are similar to those of
- (a) Low pass filters (b) High pass filters
(c) Notch filters (d) Band stop filters
44. The power in a 3-phase, 3-wire load is measured using two 100 W full scale wattmeters W_1 and W_2 . W_1 is of a accuracy class $\pm 1\%$ and reads 100 W. W_2 is of a accuracy class 0.5% and reads -50 W. Then the uncertainty in the computation to total power is
- (a) $\pm 1.5\%$ (b) $\pm 0.5\%$
(c) $\pm 4\%$ (d) $\pm 3\%$
45. Air friction damping should not be used where the deflecting torque in the instrument is produced due to
- (a) Magnetic field (b) Electrostatic field
(c) Thermo-electric emf (d) None of these

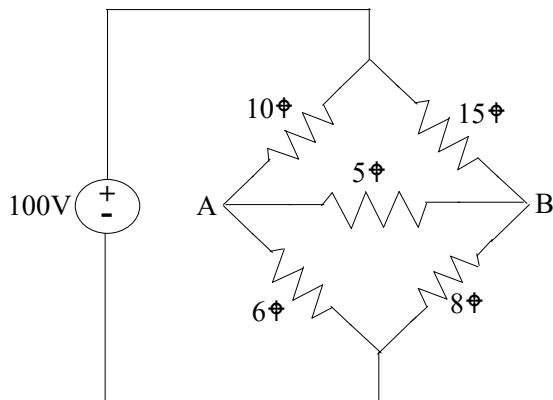
46. Which of the following instruments will have the same calibration on both AC and DC?
- (a) Electrodynamometer type
 - (b) Moving iron type
 - (c) Moving coil type
 - (d) Induction type
47. Clamp-on ammeter is used for
- (a) Low AC current
 - (b) High AC current
 - (c) Low DC current
 - (d) High DC current
48. 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
49. Electrical conductivity of copper reduces with addition of a small amount of nickel because
- (a) The mobility decreases due to creation of new scattering centers for electrons
 - (b) Nickel is ferromagnetic
 - (c) Less free electrons are available for conduction
 - (d) The electrons of copper become bound to nickel atoms and are not free to move.
50. Some of the electrons are injected into the interior of a conductor surrounded by an insulator. The injected electrons will
- (a) distribute themselves uniformly
 - (b) distribute themselves randomly
 - (c) be confined at the point of injection
 - (d) travel to the surface of the conductor

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

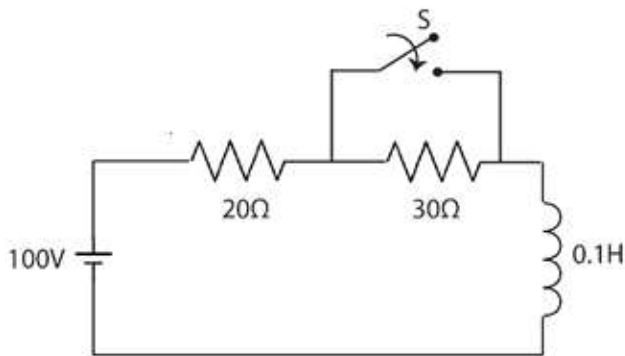
All questions carry equal marks of 5 each.

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

- (a) Two wires carrying current in the same direction attract each other. But two beams of electrons travelling in the same direction repel each other. Explain why. (3)
(b) The electric potential is constant in a region. What can we say about the electric field? (2)
- A sphere of radius 10cm has an unknown charge. If the electric field 20cm from the centre of the sphere is $2 \times 10^4 \text{ NC}^{-1}$ and points radially inward. What is the net charge on the sphere?
- Using Thevenin's theorem, find the current through the 5Ω resistor in the circuit shown below.



- For the circuit shown below, find the complete expression for the current when the switch is closed at $t=0$.



- List out some of the characteristic features of superconductors comparing with that of normal conductors.
- Distinguish between a metal, a semiconductor, and an insulator on the basis of their energy band structure.
- Define the term ceramics. List the general characteristics of ceramic materials.
- A 3-phase 500V motor load has a power factor of 0.4. Two wattmeters connected to measure the input power show the input to be 30kW. Find the reading of each instrument.
- Draw the circuit of a Wheatstone bridge and derive the condition of balance.

10. Briefly explain active and passive transducers with examples.
11. Draw and explain the working of a 2 bit flash type analog to digital converter.
12. Define semi-conducting materials and compare intrinsic and extrinsic semiconducting materials.
13. Describe with sketch B-H curve. State effect of change in temperature on area of B-H curve.
14. Starting from Maxwell's equations derive the expression for Poynting vector and explain its significance.
15. What are the various techniques by which damping torque is produced in an electrical measuring instrument? Explain them briefly.
16. Draw the block diagram of an electronic voltmeter and explain its operation.
17. Using Gauss's law, determine the electric field intensity due to an infinite sheet charge of uniform surface charge density.
18. Discuss the nature of electric field in both conductor and dielectric material.
19. Describe Hall effect and state its applications.
20. State the divergence theorem and explain its significance.

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