MIZORAM PUBLIC SERVICE COMMISSION

TECHNICAL COMPETITIVE EXAMINATIONS FOR JUNIOR GRADE OF MIZORAM ENGINEERING SERVICE (COMBINED) UNDER VARIOUS DEPARTMENT, GOVERNMENT OF MIZORAM, JULY-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. A delta circuit has each element of value R/2. The equivalent elements of star circuit will be

(a) R/3 (b) R/6

(c) 2R (d) 3R

2. The circuit has resistors, capacitors and semi-conductor diodes. The circuit will be known as

(a) non-linear circuit (b) linear circuit

(c) bilateral circuit (d) none of the above

3. For a two-port symmetrical bilateral network, if A = 3 and B = 1, the value of the parameter C will be

(a) 4 (b) 6

(c) 16 (d) 8

4. The voltage applied across a capacitance is triangular in waveform. The waveform of the current is

(a) triangular (b) rectangular

(c) sinusoidal (d) trapezoidal

5. A balanced 3-phase,3-wire supply feeds balanced star connected resistors. If one resistor is disconnected, then the percentage reduction in the load will be

(a) 33.33 % (b) 50%

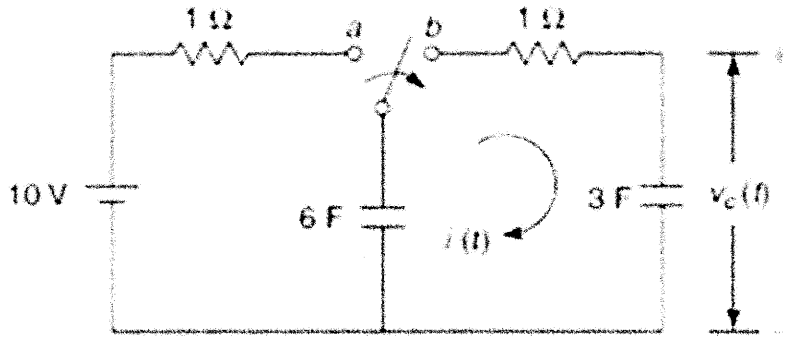
(c) 66.66% (d) 75%

6. Laplace transform of unit ramp function starting at $t = a$ is

(a) $\frac{e^{-as}}{s^2}$ (b) $\frac{e^{-as}}{(s+a)^2}$

(c) $\frac{1}{(s+a)^2}$ (d) $\frac{a}{s^2}$

7. In the below circuit, the switch is moved from a to b at t = 0, the i(t) will be



(a) $10e^{-10t}$ (b) $e^{-0.5t}$

(c) $0.5e^{-0.5t}$ (d) $10e^{-0.5t}$

8. Maxwell's divergence equation in case of static electric field is

(a) $\nabla.E = \rho$ (b) $\nabla XE = \rho$

(c) $\nabla.E = \frac{\rho}{\varepsilon_0}$ (d) $\nabla.E = 0$

9. Electrostatic field is

(a) solenoidal (b) conservative

(c) both solenoidal and conservative (d) sometimes solenoidal, sometimes conservative

10. Find the Lorentz force due to a conductor of length 2m carrying a current of 1.5A and magnetic flux density of 12 units.

(a) 24 (b) 32

(c) 36 (d) 45

11. The force between two charges is 200 N. If the distance between the charges is doubled, the force will be

(a) 400N (b) 100N

(c) 200N (d) 50N

12. Calculate the energy in an electric field with flux density 6 units and field intensity of 4 units.

(a) 12 (b) 24

(c) 36 (d) 48

13. On which of the following factors does the resistivity of a material depend?

(a) Resistance of the conductor (b) Area of the conductor section

(c) Length of the conductor (d) All of these

14. In a superconductor the value of critical density depends upon

(a) magnetic field strength (b) temperature

(c) both (a) & (b) (d) either (a) or (b)

15. Surface resistance of an insulating material is reduced due to the

(a) smoky and dirty atmosphere (b) humidity in the atmosphere

(c) both (a) & (b) (d) neither (a) nor (b)

16. A series R-L-C circuit will have unity power factor if it is operated at a frequency

(a) 1/LC (b) $1/\omega\sqrt{LC}$

(c) $1/\omega LC$ (d) $1/2\pi\sqrt{LC}$

17. Time constant of a series RC circuit is

(a) RC (b) R/C

(c) C/R (d) 1/(RC)

18. Magnetic susceptibility ferro-magnetic materials is

(a) $+10^{-5}$ (b) -10^{-5}

(c) 10^{5} (d) 10^{-5} to 10^{-2}

19. What is the conductivity when the Hall Effect coefficient is 5 and mobility is $5cm^2/s$?

(a) 100 S/m (b) 10 S/m

(c) 0.0001S/m (d) 0.01 S/m

20. Frequency can be measured by using

(a) Maxwell's bridge (b) Schering bridge

(c) Kelvin double bridge (d) Wien's bridge

21. PMMC type instruments normally use

(a) Air friction damping (b) Fluid friction damping

(c) Eddy current damping (d) None of these

22. Ohm's law in point form in field theory can be expressed as

(a) V=RI (b) $J=E/\sigma$

(c) $J=\sigma E$ (d) $R=\rho l/A$

23. For measuring a very high resistance we should use

(a) Kelvin's double bridge (b) Wheat stone bridge

(c) Meggar (d) None of these

24. Poynting vector is

(a) The current density vector producing electrostatics field

(b) The current density vector producing electromagnetic field

(c) The power density vector producing electrostatics field

(d) The power density vector producing electromagnetic field

25. Form factor of sine wave is

(a) 0.637 (b) 0.707

(c) 1.11 (d) 1.414

26. Two coils having self-inductances 15 mH and 5 mH and mutual inductance 1 mH are connected in series with adding mode. The equivalent Inductance of the circuit is

(a) 22.2 mH (b) 19.8 mH

(c) 21 mH (d) 22 mH

27. At t = 0+ with zero initial condition, which of the following will act as short circuit?

(a) Inductor (b) Capacitor

(c) Resistor (d) None

28. A moving-coil permanent-magnet instrument can be used as flux-meter

(a) by using a low resistance shunt

(b) by using a high series resistance

(c) by eliminating the control springs

(d) by making control springs of large moment of inertia

29. In majority of instruments damping is provided by

(a) fluid friction (b) spring

(c) eddy currents (d) all of these

30. For a distortion less line the parameters are related as

(a) R/G=C/L (b) R/G=L/C

(c) RG=LC (d) R/L=1

31. Polarization in dielectric material is due to creation of

(a) Electric field (b) Electromagnetic field

(c) Eddy currents (d) Electric dipole

32. Which of the following is applicable for both linear and non-linear circuits?

(a) Thevnin's theorem. (b) Norton's theorem.

(c) Superposition theorem. (d) None of these

33. If $a = 4 < 20°$ and $b = 2 < 10°$ then the value of a/b, will be

(a) $2 < 10°$ (b) $2 < 30°$

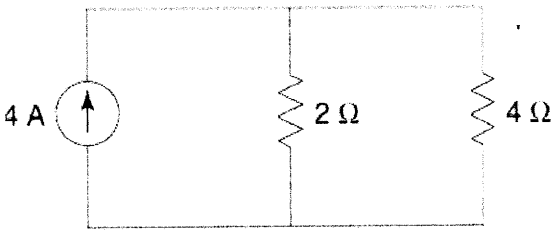
(c) $2 < -10°$ (d) $2 < 20°$

34. The number of comparator circuits required to build a three-bit simultaneous A/D converter is :

(a) 15 (b) 7

(c) 8 (d) 16

35. The current in the 4 Ω resistor shown in network of Figure.



(a) 1.33 A (b) 2.66 A

(c) 1.5 A (d) 2.33 A

36. A voltmeter uses 4½ digit display. What will be the resolution?

(a) 0.00001 (b) 0.01

(c) 0.0001 (d) 0.001

37. Creeping in a single phase induction type energy meter may be due to:

(a) Overcompensation for friction (b) Overvoltage

(c) Vibrations (d) All of these

38. Which instrument cannot be used both for a.c. & d.c. measurements?

(a) Dynamometer type (b) Induction type

(c) Electrostatic type (d) Moving iron type.

39. A Wheatstone bridge cannot be used for precision measurements because error due to

(a) Resistance of connecting leads (b) Thermo-electric emf

(c) Contact resistance (d) All of these

40. A 1mA ammeter has a resistance of 100 ohms. It is to be converted to a 1A ammeter. The value of shunt resistance is

(a) 0.001ohm (b) 0.1001 ohm

(c) 100000 ohm (d) 100 ohm

41. The instrument, which gives the value of the quantity to be measured in terms of instrument constant & its deflection, is called the

(a) Absolute instrument (b) Secondary instrument

(c) Recording instrument (d) Integrating instrument

42. In measurement systems, which of the following static characteristic(s) is/are desirable?

(a) Accuracy (b) Sensitivity

(c) Reproducibility (d) All of these

43. The electric field at a point situated at a distance d from straight charged conductor is

(a) proportional to d (b) inversely proportional to d

(c) inversely proportional to d (d) none of these

44. The ability of charged bodies to exert force on one another is attributed to the existence of

(a) electrons (b) protons

(c) neutrons (d) electric field

45. "The total electric flux through any closed surface surrounding charges is equal to the amount of charge enclosed". The above statement is associated with

(a) Coulomb's square law (b) Gauss's law

(c) Maxwell's first law (d) Maxwell's second law

46. The magnitude of the induced e.m.f. in a conductor depends on the

(a) flux density of the magnetic field (b) amount of flux cut

(c) amount of flux linkages (d) rate of change of flux-linkages

47. A ferrite core has less eddy current loss than an iron core because

(a) ferrites have high resistance (b) ferrites are magnetic

(c) ferrites have low permeability (d) ferrites have high hysteresis

48. Silicon steel is used in electrical machines because it has

(a) low co-ercivity (b) low retentivity

(c) low hysteresis loss (d) high co-ercivity

49. In a magnetic material hysteresis loss takes place primarily due to

(a) rapid reversals of its magnetisation (b) flux density lagging behind magnetising force

(c) molecular friction (d) it high retentivity

50. For which of the following materials the net magnetic moment should be zero?

(a) Diamagnetic materials (b) Ferrimagnetic materials

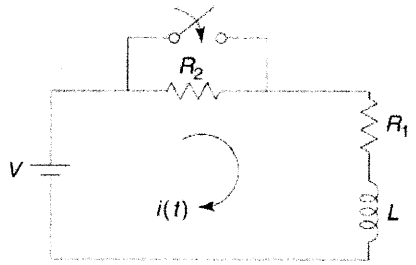
(c) Antiferromagnetic materials (d) Antiferrimagnetic materials

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

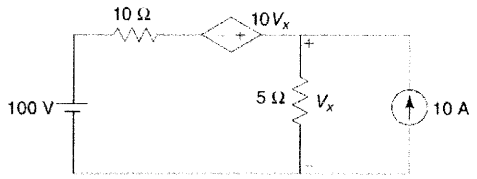
All questions carry equal marks of 5 each.

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

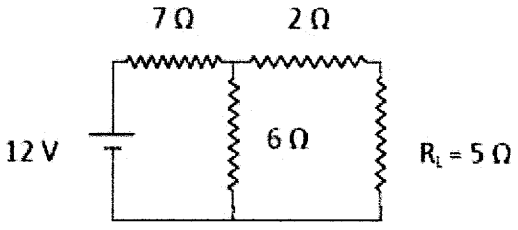
1. From Ampere's circuital law, Prove that $\nabla XH = J + \frac{\partial D}{\partial t}$.
2. State and explain the Superposition theorem for DC (or AC) circuits with independent or dependent sources.
3. Explain briefly soft magnetic materials and hard magnetic materials.
4. Explain briefly hysteresis loop with neat sketch.
5. Explain the formation of N-type semiconductor.
6. In the network shown in figure, the switch is closed at t=0, a steady state having previously been attained. Find the current i (t).



7. Explain briefly the principle of operation of Permanent Magnet Moving Iron (PMMI) instrument with proper circuit diagram.
8. Describe briefly the construction and operation of a Digital multimeter.
9. Determine the current through the 10 Ω resistor in figure.



10. Using Thevenin's theorem find out the current flowing through the 5 Ω resistance as shown in the following figure:



11. A three phase balanced load operating at 230V has a power factor of 0.7. Two-watt meters are connected to measure the power which shows the input to be 10 kW. Find the reading of each wattmeter.
12. (a) Obtain the expression for the rms value of sinusoidal current in terms of its maximum value. **(2)**

    (b) Find the rms value of a composite waveform $v(t) = 7 \sin(\omega t) + 10 \sin(\omega t + \pi/3)$. Here all the symbols have their usual meaning. **(3)**

13. Define the terms Accuracy, Precision, Resolution, Drift and Relative limiting error.
14. Derive the balance equations for Schering Bridge for measurement of capacitance.
15. State and proof divergence theorem.
16. Define divergence, gradient, curl in spherical co-ordinate system with mathematical expression.
17. Derive the expressions for boundary conditions in magnetic fields.
18. State the requirements of low resistivity materials and high resistivity materials.
19. Draw and explain briefly the energy level diagrams of conductors, insulators and semiconductors.
20. Explain briefly, how to measure low resistances using Kelvin's double bridge. Derive the necessary equations.

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