MIZORAM PUBLIC SERVICE COMMISSION

TECHNICAL COMPETITIVE EXAMINATIONS FOR JUNIOR GRADE OF MIZORAM ENGINEERING SERVICE (M.E.S.) UNDER PUBLIC HEALTH DEPARTMENT, GOVERNMENT OF MIZORAM, MARCH, 2019.

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. If D is the electric flux density, then the value of electric intensity in air is

(a) D/ϵ_o (b) $D/\epsilon_o \epsilon_r$

(c) dV/dt (d) $Q/\epsilon A$

2. According to Gauss's theorem, the surface integral of the normal component of electric flux density D over a close surface containing charge Q is

(a) Q (b) Q/ϵ_o

(c) $\epsilon_o Q$ (d) Q^2/ϵ_o

3. In practice, Earth is chosen as a place of zero electric potential because it

(a) is non-conducting

(b) is easily available

(c) keeps loosing and gaining electric charge every day

(d) has almost constant potential

4. Inside a conducting sphere, _____ remains constant.

(a) electric flux (b) electric intensity

(c) charge (d) potential

5. With the rise of temperature, dielectric strength of material

(a) increase (b) remain constant

(c) decreases (d) becomes zero

6. If small charge drops are combined to give a bigger drop, the rise in potential will be

(a) directly proportional to the radius of the bigger drop

(b) directly proportional to the square of the radius of the bigger drop

(c) inversely proportional to the square of the radius of the bigger drop

(d) inversely proportional to the radius of the bigger drop

7. A thunder cloud above the earth sets up a vertical electric field of 50 volts/metre. In this field there is a rain drop carrying a charge of 0.3 micro-coulomb. The electrostatic force on this drop will be

(a) 15×10^{-6} N (b) 15×10^{-9} N

(c) 15×10^{9} N (d) 15×10^{6} N

8. An electric field is parallel but opposite to a magnetic field. Electrons with some initial velocity enter the region of the fields at an angle] along the direction of the electric field. The electron path will be

(a) Circular (b) cycloidal

(c) Helical (d) straight

9. A metal surface has a positive charge of 10^{-9} C. How many electrons would have been removed from the metal surface?

(a) 6.25×10^{9} (b) 6.25×10^{6}

(c) 1.6×10^{-19} (d) 1.6×10^{9}

10. When a soap bubble is charged

(a) It contracts (b) it expands

(c) It bursts (d) it neither contracts nor expands

11. On rotating a point charge, having charge 'q' around a charge 'Q' in a circle of radius r, the work done will be

(a) $q \times 2\pi r$ (b) $(q \times 2\pi Q)/r$

(c) Zero (d) $Q/(2\varepsilon_o r)$

12. If a charge Q is situated at the centre of a cube. The electric flux through one of the face of the cube is

(a) Q/ε_o (b) $Q/2\varepsilon_o$

(c) $Q/4\varepsilon_o$ (d) $Q/6\varepsilon_o$

13. A small piece of an unmagnetised substance gets repelled when it is brought near a powerful magnet. Then the substance can be

(a) Paramagnetic (b) ferromagnetic

(c) Non-magnetic (d) diamagnet

14. On which of the following factor hysteresis loss does not depend?

(a) Magnetic field intensity (b) frequency of the field

(c) Volume of the material (d) none of these

15. The relative permeability of paramagnetic materials is

(a) Very high (b) slightly more than one

(c) Equal to one (d) less than one

16. The conductivity of ferrites is

(a) Less than that of ferromagnetic materials

(b) Equal to that of ferromagnetic materials

(c) Greater than that of ferromagnetic materials

(d) Very high than that of ferromagnetic materials

17. In ceramic insulators, glazes are used to improve

(a) Mechanical properties (b) Chemical properties

(c) Electrical properties (d) None of these

18. The impurity atoms in semiconductors

(a) reduce the energy gap

(b) increase the kinetic energy of valence electrons

(c) Inject more charge carriers

(d) all of these

19. The material used for photo conductive cell is

(a) ZnS (b) PbS

(c) CdS (d) none of these

20. With increase in temperature, the conductivity of an extrinsic semiconductor

(a) decrease (b) increase

(c) remain constant (d) none of these

21. When acceptor type impurity is added to a semiconductor material

(a) electrons are generated and materials is called N-type

(b) electrons are generated and materials is called P-type

(c) holes are generated and the materials is called N-type

(d) holes are generated and materials is P-type

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

(a) movement of holes in conduction band

(b) movements of electrons in conduction band

(c) movement of electrons in valence band

(d) movement of holes in valence band

23. Fermi energy is the amount of energy which

(a) a valence electron can have at room temperature

(b) must be given to an electron to move it to conduction band

(c) must be given to a hole to move it to valance band

(d) a hole can have at room temperature

24. Hall's effect can be used to measure

(a) electric field intensity (b) magnetic field intensity

(c) carrier concentration (d) none of these

25. The minority carrier concentration is largely a function of

(a) the amount of doping (b) temperature

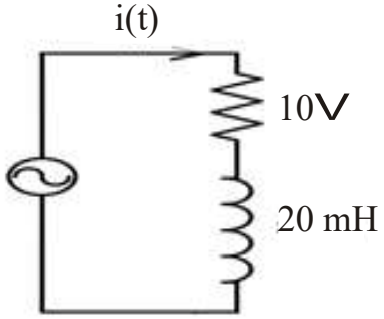
(c) forward biasing voltage (d) reverse biasing voltage

26. If there are b branches and n nodes, the number of equation is given by

(a) b (b) b-n

(c) n-1 (d) (b-n+1)

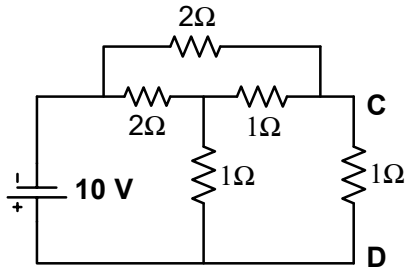
27. The current flowing in the circuit shown below is i(t)=2sin500t A. The applied voltage will be



(a) 20 sin 500t V (b) 20 cos 500t V

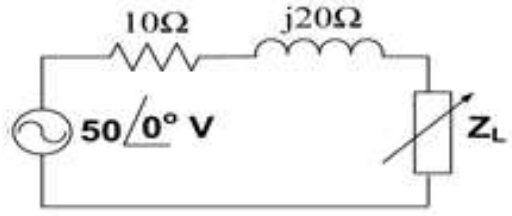
(c) 28.28 sin (500t+45°) V (d) 30.5 cos (500t+30°) V

28. The current flowing in the branch CD is equal to



(a) 10 A
(b) 5 A
(c) 3.33 A
(d) 2.3 A

29. The maximum power in the load is



(a) 25 W
(b) 30.6 W
(c) 62.5 W
(d) 110 W

30. At half power frequency, the current in RLC series circuit is

(a) $\frac{1}{2}$ of current at resonance
(b) $\frac{1}{\sqrt{3}}$ of current at resonance
(c) $\frac{1}{4}$ of current at resonance
(d) $\frac{1}{\sqrt{2}}$ of current at resonance

31. If a capacitor is charged by a square wave current source, the voltage across the capacitor is

(a) A square wave
(b) triangular wave
(c) Step function
(d) zero

32. Pick the correct statement

(a) Delta connection draw same current as star connection
(b) Delta connection draw 3 times as much current as star connection
(c) Delta connection draws $\frac{1}{\sqrt{3}}$ times as much current as star connection
(d) Delta connection draws $\frac{1}{3}$ times as much current as star connection

33. Superposition theorem is not valid for

(a) Voltage responses
(b) Current responses
(c) Power responses
(d) All of these

34. In a three phase balanced delta connected system, the phase relation between the line currents and their respective phase currents is given by

(a) The line currents lag behind their respective phase currents by 30^o
(b) The phase currents lag behind their respective line currents by 30^o
(c) The line currents lag behind their respective phase currents by 45^o
(d) The phase currents lag behind their respective line currents by 45^o

35. The transient response occurs

(a) Only in resistive circuits
(b) only in inductive circuits
(c) Only in capacitive circuits
(d) both in (b) and (c)

36. The transient current in RLC circuit is oscillatory when

(a) $R = 2\sqrt{L/C}$
(b) $R = 0$
(c) $R > 2\sqrt{L/C}$
(d) $R < 2\sqrt{L/C}$

37. In describing the transmission parameters

(a) The input voltage and current are express in terms of output voltage and current
(b) The input voltage and output voltage are express in terms of output current and input current
(c) The input voltage and output current are express in terms of input current and output voltage
(d) None of these

38. For a two-port bilateral network, the three transmission parameters are given by A=6/5; B=17/5 and C=1/5, what is the value of D?

(a) 1
(b) 1/5
(c) 7/5
(d) 5/7

39. The accuracy of moving coil instruments as compared to moving iron instruments is

(a) High
(b) low
(c) same
(d) very low

40. The energy meter used for measuring energy of d.c circuit is

(a) ampere hour type
(b) induction type
(c) electrostatic type
(d) dynamometer type

41. No eddy current and hysteresis losses occur in

(a) electro-static instruments
(b) PMMC type instruments
(c) moving iron instruments
(d) none of these

42. Schering bridge is used to measure

(a) dielectric loss
(b) the inductance
(c) low resistance
(d) mutual inductance

43. Inductance is measured by

(a) Wien bridge
(b) Schering bridge
(c) Maxwell's bridge
(d) Hay bridge

44. Which of the following instrument can be used for measurement of alternating current only?

(a) Permanent magnet type ammeter
(b) Induction type ammeter
(c) Moving iron voltmeter
(d) Moving iron ammeter

45. In two wattmeter method of measuring 3-phase power, power factor is 0.5, then one of the wattmeter will read

(a) W/2
(b) Zero
(c) $\sqrt{2}$ W
(d) $\frac{W}{\sqrt{3}}$

46. The speed of energy meter can be controlled by

(a) Series magnet
(b) Braking magnet
(c) Shunt magnet
(d) Shading Band

47. In an instrument, the error when reading at half-scale is

(a) Less than full-scale error
(b) Equal to full scale error
(c) Greater than full scale error
(d) Equal to half of full scale error

48. The minimum number of wattmeters required to measure the real power in an N phase system with unbalanced load is

(a) (N-1)
(b) N
(c) (N+1)
(d) None of these

49. A wattmeter can measure

(a) a.c power only
(b) d.c power only
(c) a.c as well as d.c power
(d) d.c power and a.c power after rectifications

50. Which of the following devices is used to measure flow of air around an aeroplane?

(a) Venturimeter
(b) Rotameter
(c) Orifice
(d) Anemometer

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. Eight charged water droplets, each with a radius of 1 mm and a charge of 10^{-9} C coalesce to form a single drop. Calculate the potential of the bigger drop.

2. Calculate the magnetic field at the centre of a coil in the form of a square of side 4 cm, carrying a current of 5A.

3. Write the integral form and differential form of Maxwell's equations derived from

(a) Ampere's circuital law
(b) Faraday's Law
(c) Gauss's Law

4. Find the velocity of a plane wave in a loss less medium having a relative permittivity of 5 and relative permeability of unity.

5. Two fixed point charges 4Q and 2Q are separated by a distance 'X'. Where should the third point charge 'q' be placed for it to be in equilibrium?

6. Explain why the conductivity of intrinsic semiconductors increases with the increase in temperature while that of metals decreases?

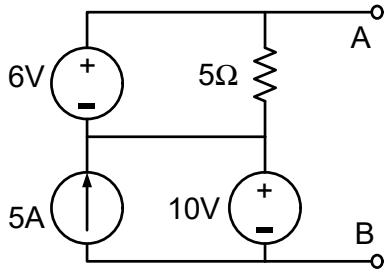
7. Carbon, Germanium and silicon are all tetravalent. They have similar covalent bond structure. Why is carbon not used as a semiconductor?

8. Briefly explain the formation of energy bands in solid. On the basis of energy bands, distinguish between (i) a metal (ii) insulator and (iii) a semiconductor.

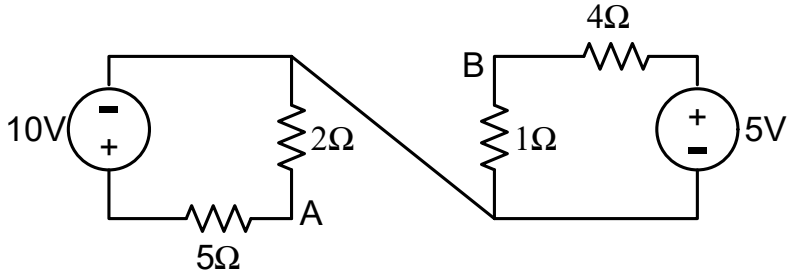
9. Explain why there is a very small current across the junction, when a p-n junction diode is reversed biased. Does it depend on the applied voltage?

10. A silicon p-n junction has a reverse saturation current of I_o=30nA at a temperature of 300K. Calculate the junction current when the applied voltage is 0.7 V forward bias.

11. Determine the voltage across the terminal AB in the circuit shown below



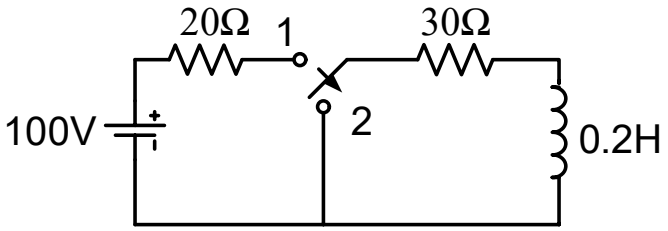
12. Determine the Thevenin's equivalent circuit across terminals AB in the circuit shown below



13. A series RLC circuit consists of 50V resistance, 0.2H inductance and 10μF capacitance with the applied voltage of 20V. Determine the resonant frequency and also find the Q factor of the circuit.

14. A balance star-connected load of (4+J3) V per phase is connected to a balanced 3-phase 400V supply. The phase current is 12A. Find (a) the total active power, (b) reactive power and apparent power.

15. For the circuit shown below, find the current equation when the switch is changed from position 1 to position 2 at t=0.

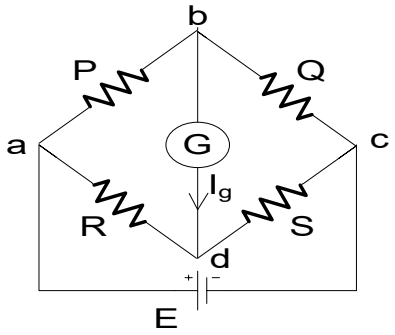


16. A dynamometer type wattmeter with its voltage coil connected across the load side reads 192W. The load voltage is 208V and the resistance of the potential coil circuit is 3825 V. Calculate (a) true load power and (b) percentage error due to wattmeter connection.

17. Calculate the value of the LSB, MSB, and full-scale output for an 8-bit DAC for the 0 to 10V range.

18. What is a thermocouple? Briefly explain how temperature is measured using thermocouple.

19. The values of resistances for the Wheatstone bridge shown below are as follows: P = 1 KV, R = 1 KV, S = 5 KV, G = 100 V. The Thevenin source generator voltage E_o = 24 mV and the galvanometer current is 13.6 μA. Calculate the value of Q.



20. What is a transducer? Briefly explain the difference between passive transducer and active transducer each with an example.

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