MIZORAM PUBLIC SERVICE COMMISSION

COMPETITIVE EXAMINATIONS FOR JUNIOR GRADE OF M.E.S. UNDER POWER & ELECTRICITY DEPARTMENT, JULY, 2018.

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. What is the value of total electric flux coming out of a closed surface?
(a) Zero
(b) Equal to volume charge density
(c) Equal to the total charge enclosed by the surface
(d) Equal to the surface charge density

2. In the left hand rule, forefinger always represents
(a) Voltage
(b) Current
(c) Direction of force on the conductor
(d) Magnetic field

3. An electromagnetic field is said to be conservative when
(a) $\nabla^2 E = \mu \in \left(\frac{\partial^2 E}{\partial t^2} \right)$
(b) $\nabla^2 H = \mu \in \left(\frac{\partial^2 H}{\partial t^2} \right)$
(c) Curl of the field is zero
(d) Divergence of the field is zero

4. The unit of $\nabla \times H$ is
(a) Ampere
(b) Ampere/meter
(c) Ampere-meter
(d) Ampere/meter^2

5. The transmission line whose characteristic impedance is a purely resistive
(a) Must be a lossless line
(b) Must be a distortionless line
(c) May not be a lossless line
(d) May not be a distortionless line

6. A Yagi antenna has a driven antenna
(a) Only
(b) With a reflector
(c) With one or more directors
(d) With a reflector and one or more directors

7. The Maxwell's equation $\nabla \times H = J + \frac{\partial \bar{D}}{\partial t}$ is based on

(a) Ampere's law
(b) Gauss's law
(c) Faraday's law
(d) Coulomb's law.

8. A transmission line of 50 W characteristic impedance is terminated with a 100 W resistance. The minimum impedance measured on the line is equal to

(a) 0
(b) 25 W
(c) 50 W
(d) 100 W

9. A cavity resonator can be represented by

(a) An LC circuit
(b) An LCR circuit
(c) A lossy inductor
(d) A lossy capacitor

10. Which one of the following sets of equations is independent in Maxwell's equations?

(a) The two curl equation
(b) The two divergence equations
(c) Both the curl and divergence equations
(d) The two curl equations combined with the continuity equation

11. A rectangular air filled waveguide has cross section of 4 cm x 10 cm. The minimum frequency which can propagate in the waveguide is

(a) 1.5 GHz
(b) 2.0 GHz
(c) 2.5 GHz
(d) 3.0 GHz

12. Which one of the following materials is a ceramic materials?

(a) Mica
(b) Zinc sulphide
(c) Antimony
(d) Copper

13. Ferrites have

(a) Low copper loss
(b) Low eddy current loss
(c) Low resistivity
(d) High specific gravity compared to iron

14. Dielectric materials are used primarily for

(a) Insulation
(b) Charge storage
(c) Reducing dielectric loss
(d) None of these

15. N-type germanium is obtained on doping intrinsic germanium by

(a) Phosphorous
(b) Aluminium
(c) Boron
(d) Gold

16. Bakelite is

(a) A semiconductor
(b) Incombustible
(c) Low resistance conductor
(d) Highly inflammable

17. Which one of the following is an essential component of electromechanical relays?

(a) Graphite rod
(b) LED
(c) An electromagnet
(d) MOSFET

18. The magnetic permeability is maximum for

(a) Paramagnetic materials
(b) Ferromagnetic materials
(c) Diamagnetic materials
(d) None of these

19. For which one of the following materials is the Hall coefficients zero?

(a) Metals (b) Insulators

(c) Intrinsic semiconductor (d) Alloy

20. Which one of the following materials has the highest dielectric strength?

(a) Polystyrene (b) Marble

(c) Cotton (d) Transformer oil

21. Metallic copper is a

(a) Paramagnetic substance (b) Diamagnetic substance

(c) Ferromagnetic substance (d) Ferrrimagnetic substance

22. Magnetic recording tape is most commonly made from

(a) Small particles of iron (b) Silicon iron

(c) Ferric-oxide (d) Silver nitrate

23. Magnetostriction is a phenomenon of

(a) Generation of electricity in ferromagnetic materials

(b) Generation of magnetism in conductors

(c) Change in permeability of ferromagnetic materials during magnetisation

(d) Change in physical dimensions of ferromagnetic materials during magnetisation

24. Assuming the Fermi level E_F to be independent of temperature, E_F may be defined as the level with an occupancy probability of

(a) 0% (b) 50%

(c) 75% (d) 100%

25. When temperature of a conductor is approaching zero Kelvin. The mean free path of the free electrons in the conductor is proportional to

(a) T (b) T^3

(c) $(1/T)^{1/3}$ (d) $1/T^3$

26. A 3 H inductor has 2000 turns. How many turns must be added to increase the inductance to 5 H?

(a) 1000 turns (b) 2500 turns

(c) 2582 turns (d) 582 turns

27. Superposition theorem is not applicable for

(a) Voltage calculation (b) Bilateral elements

(c) Power calculations (d) Passive elements

28. A particular current is made up of two components a 10 A dc and a sinusoidal current of peak value of 14.14 A. The average value of resultant current is

(a) Zero (b) 10 A

(c) 14.14 A (d) 24.14 A

29. Two, two-port network are connected in cascade. The combination is to be represented as a single two port network. The parameters of the network are obtained by the multiplying the individuals

(a) Z -parameter matrix (b) h-parameter matrix

(c) Y-parameter matrix (d) ABCD parameter matrix

30. A Hurwitz polynomial has

(a) Zeros only in the left half of the s-plane (b) Poles only in the left half of the s-plane

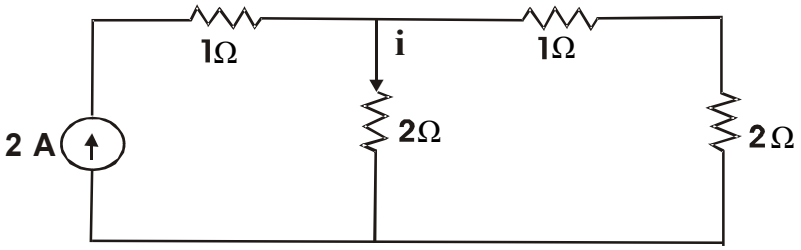
(c) Zeros anywhere in the s-plane (d) Poles on the jw axix only

31. If a unit step current is passed through a capacitor, what will be the voltage across the capacitor?

(a) Zero
(b) A step function
(c) A ramp function
(d) An impulse function

32. Determine the current *i* from the following circuit

(a) 4/5 A
(b) 6/5 A
(c) 2/5 A
(d) 7/5



33. Voltage transfer function of a simple RC integrator has

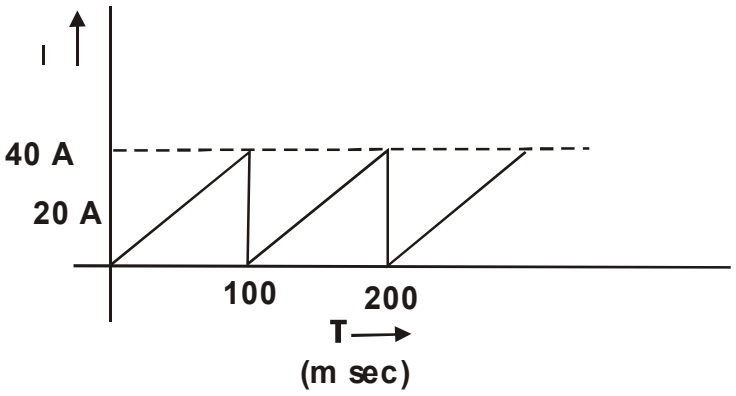
(a) A finite zero and a pole at infinity
(b) A finite zero and a pole at the origin
(c) A zero at the origin and a finite pole
(d) A zero at infinity and a finite pole

34. If each branch of a delta circuit has impedance $\sqrt{3}$ Z, then each branch of equivalent Y circuit has impedance

(a) $\frac{Z}{\sqrt{3}}$
(b) Z
(c) $2\sqrt{3}Z$
(d) $\frac{Z}{3}$

35. Average value of current for a given saw-tooth waveform is

(a) 10 A
(b) 20 A
(c) 30 A
(d) 40 A



36. A parallel R-L-C circuit resonates at 100 kHz. At frequency 110 kHz, the circuit impedance will be

(a) Resistive
(b) Capacitive
(c) Inductive
(d) None of the above

37. The transfer function of a system $Z(s)=\frac{V(s)}{I(s)}=\frac{s}{s+3}$. The system is at rest for t < 0. What will be the value of V(t) for $t \geq 0$, if i(t)=3u(t), where u(t) is a unit step?

(a) e^{-t} (b) $2e^{-3t}$

(c) $3e^{-3t}$ (d) $4e^{-t}$

38. A two port network is reciprocal, if and only if

(a) $Z_{11} = Z_{12}$ (b) $Y_{12} = -Y_{21}$

(c) $h_{12} = h_{21}$ (d) BC –AD = -1

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

(a) Standard resistance (b) Standard inductance

(c) Standard capacitance (d) Standard mutual inductance

40. In a two-wattmeter method of measuring power one of the wattmeter is reading zero watts. The power factor of the circuit is

(a) Zero (b) 1

(c) 0.5 (d) 0.8

41. No eddy current and hysteresis losses occur in

(a) Electrostatic instruments (b) PMMC type instruments

(c) Moving iron instruments (d) Electrodynamometer instruments

42. The phenomena of 'creeping' occurs in

(a) Ammeters (b) Voltmeters.

(c) Watt meters (d) Watt-hour meters

43. 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

44. Torque/weight ratio of an instrument indicates

(a) Selectivity (b) Sensitivity

(c) Accuracy (d) Fidelity

45. The pressure coil of a single phase house service energy meter is

(a) Highly resistive (b) Highly inductive

(c) Purely resistive (d) Purely inductive

46. The resistance of a circuit is found by measuring current flowing and the power fed into the circuit. If the limiting errors in the measurement of power and current are $\pm 1.5\%$ and $\pm 1.0\%$ respectively. The limiting error in the measurement of resistance will be

(a) $\pm 1\%$ (b) $\pm 1.5\%$

(c) $\pm 2.5\%$ (d) $\pm 3.5\%$

47. The meter constant a single phase 240 V induction wattmeter is 400 revolutions per kWh. The speed of the meter disc for a current of 10 Amps of 0.8 p.f. lagging will be

(a) 12.8 rpm (b) 16.02 rpm

(c) 18.2 rpm (d) 21.1 rpm

48. 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 D.C. voltage is

(a) Nearly 100 mV (b) Nearly 50 mV

(c) Nearly 25 mV (d) Nearly 5.0 mV

49. A 12 bit A/D converter has a range 0-10 V. What is the approximate resolution of the converter?

(a) 1 mV (b) 2.5 mV

(c) 2.5 μV (d) 12 mV

50. Schering bridge can be used to measure

(a) Capacitance and its power factor (b) 'Q' of a coil

(c) Inductance and 'Q' value (d) Very small resistance

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. State Ampere's circuital law and prove that $\nabla \times H = J$ for a steady magnetic field. **(5)**

2. State the Maxwell's Equations with mathematical expression. **(5)**

3. What is meant by magnetic hysteresis? Draw and explain the B-H curves for a ferromagnetic material. **(1+4=5)**

4. A ring has a diameter of 21 cm and a cross-sectional area of 10 cm^2. The ring is made up of semicircular sections of cast iron and cast steel with each joint having reluctance equal to an air-gap of 0.2 mm. Find the ampere-turns required to produce a flux of 8 x 10^{-4} Wb. The relative permeability of cast steel and cast iron are 800 and 166 respectively. Neglect fringing and leakage effects. **(5)**

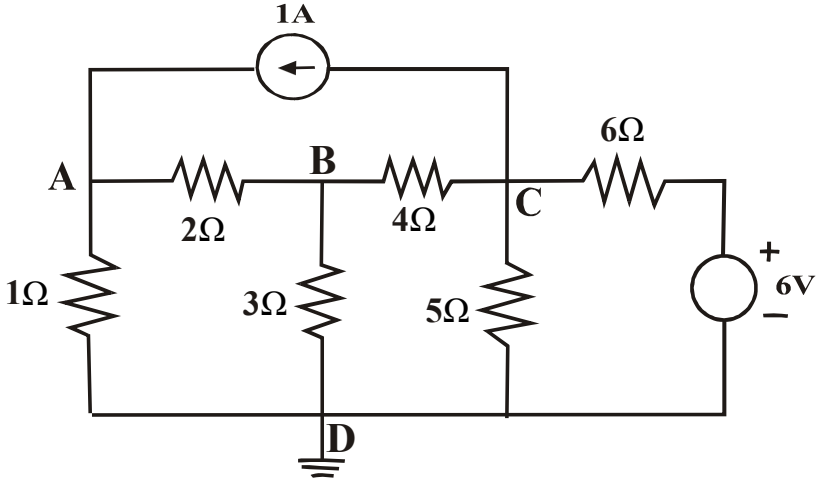
5. What is semiconductor? How do they differ from conductors and insulators? Why an increase in temperature increases conductivity of a semiconductor? **(1+2+2=5)**

6. Explain the movement of electrons and holes in a semiconductor. In what respect N-type and P-type semiconductor differ from each other? **(3+2=5)**

7. What is Hall effect? Briefly discuss the physical origin of the Hall effect. **(1+4=5)**

8. State and prove maximum power transfer theorem. **(5)**

9. Use node voltage analysis determines the power in the 2 W and 4 W resistor in the network of fig shown in below. **(5)**

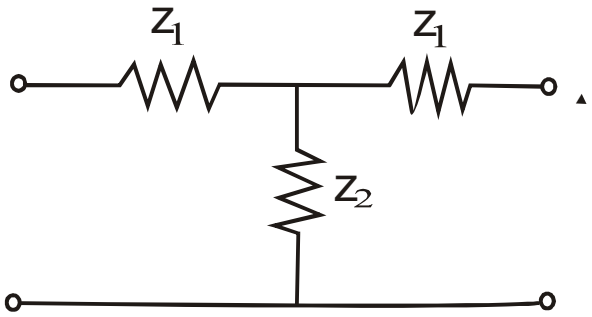


10. A balanced delta connected load of (4+ j3) W per phase is connected to a three phase 230 V supply. Find the line current, reactive VA and total VA. **(5)**

11. Explain the open circuit impedance and the short circuit admittance parameters of a four terminal network. **(5)**

12. A 240 V, 100 Hz ac source supplies a series RLC circuit consisting of a capacitor and a coil. If the coil has 55 mW resistance and 7 mH inductance, calculate the value of capacitor at 100 Hz resonance frequency, the Q factor and the half power frequency of the circuit. **(5)**

13. A symmetrical T-section has the following open-circuit and short circuit impedance: $Z_{OC} = 900\Omega$ and $Z_{SC} = 500\Omega$. Calculate the T-section parameters to represent the two port network. **(5)**



14. Explain the necessary conditions for transfer functions in a network. **(5)**

15. What is error? Briefly explain different types of error presents of an instrument and measurement system. **(1+4=5)**

16. Draw and explain the Anderson's Bridge with its phasor diagram and calculate unknown inductance using it? **(5)**

17. Explain general data acquisition system with a neat block diagram. **(5)**

18. What is transducer? What parameter should be considered in selecting a transducer -explain it? **(1+4=5)**

19. Explain the successive approximation A/D converter. **(5)**

20. A 5 bit D/A converter is used for the range of 0-10 V. Find the weight of MSB and LSB. Also find the exact range of converter and the error. **(5)**

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