

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, JUNE-2022

ELECTRONICS & COMMUNICATION 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.*

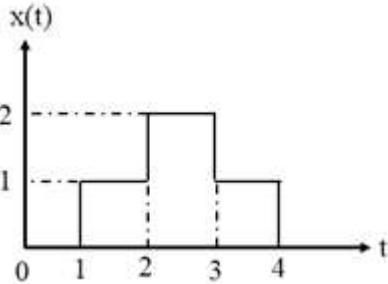
1. An intrinsic semiconductor at absolute zero temperature behaves like :
 - (a) An electron
 - (b) An insulator
 - (c) A conductor
 - (d) An ion
2. The covalent bond is formed by :
 - (a) Transfer of electrons between atoms
 - (b) Sharing of electrons between atoms
 - (c) Sharing of variable number of electrons by a variable number of atoms
 - (d) Sharing of nucleus between atoms
3. High resistivity materials are used in :
 - (a) LED light
 - (b) Heating instruments
 - (c) Tube light starter
 - (d) Cool down instruments
4. Vacant lattice sites in halide crystals cause :
 - (a) Plastic deformation and ionic conductivity
 - (b) Transparency and diffusion
 - (c) Diffusion and ionic conductivity
 - (d) Plastic deformation and transparency
5. According to the free electron theory, electrons in a metal are subjected to :
 - (a) Constant potential
 - (b) Sinusoidal potential
 - (c) Square-wave potential
 - (d) A superconductor
6. The resistivity of a metal is a function of temperature because :
 - (a) The electron density varies with temperature
 - (b) The electron gas density varies with temperature
 - (c) Collision of electrons increases as temperature increases
 - (d) The lattice vibration increases with temperature
7. When copper is added to silver in small quantity so as to form an alloy, the resistivity of such an alloy is:
 - (a) Equal to the resistivity of the copper
 - (b) Equal to the resistivity of the silver
 - (c) Greater than the resistivity of the copper
 - (d) In between the resistivity of copper and silver

8. At what condition of surrounding air, does electrochemical breakdown occur?
- (a) High temperature and high humidity (b) High temperature and low humidity
(c) Low temperature and high humidity (d) Low temperature and low humidity
9. A hall effect transducer can be used to measure :
- (a) Displacement, position and velocity (b) Displacement, temperature and magnetic flux
(c) Position, pressure and velocity (d) Energy
10. Mobility is defined as :
- (a) Diffusion velocity per unit electric field (b) Drift velocity per unit electric field
(c) Displacement per unit electric field (d) Distance per unit electric field
11. The impurity commonly used for realizing the base region of a silicon n-p-n transistor is :
- (a) Phosphorus (b) Gallium
(c) Boron (d) Indium
12. Zener diode is _____ device.
- (a) Non-linear (b) Amplifier
(c) Linear (d) Transistor
13. The reverse bias breakdown of high-speed Si transistor is due to :
- (a) Avalanche breakdown mechanism at both the junctions
(b) Zener breakdown mechanism at base-collector junction
(c) Zener breakdown mechanism at base-emitter junction
(d) Zener breakdown mechanism at collector-emitter junction
14. Which of the following is not associated with P-N junction?
- (a) Junction capacitance (b) Charge storage capacitance
(c) Depletion capacitance (d) Channel length modulation
15. In a p-channel JFET, the charge carriers are :
- (a) Electrons (b) Holes
(c) Both electrons and holes (d) Atom
16. The threshold voltage of an n-channel MOSFET can be increased by :
- (a) Increasing the channel dopant concentrations (b) Reducing the channel dopant concentrations
(c) Reducing the gate-oxide thickness (d) Reducing the channel length
17. An avalanche photo diode is operated under :
- (a) Small forward bias (b) Small reverse bias
(c) Independent of bias (d) Large reverse bias
18. Kirchhoff's laws are valid for :
- (a) linear circuits only (b) passive time-invariant circuits
(c) non-linear circuits only (d) both linear and non-linear circuits
19. A connected planar network has 4 nodes and 5 elements. The number of meshes in its dual network is:
- (a) 4 (b) 3
(c) 2 (d) 1

20. There are two wires A and B. A is 20 times longer than B and has half the cross section of that of B. If the resistance of B is $1\ \Omega$, the resistance of A will be :
- (a) 40 Ω (b) $1/40\ \Omega$
(c) 20 Ω (d) 10 Ω
21. The tree branches of a graph are called :
- (a) chords (b) links
(c) twigs (d) co-tree
22. If all the elements in a particular network are linear then the superposition theorem holds when the excitation is :
- (a) dc only (b) ac only
(c) either ac or dc (d) an impulse
23. When the diode is forward biased, it is equivalent to :
- (a) An off switch (b) An On switch
(c) A high resistance (d) A low resistance
24. A Zener diode works on the principle of :
- (a) tunnelling of charge carriers across the junction
(b) thermionic emission
(c) diffusion of charge carriers across the junction
(d) hopping of charge carriers across the junction
25. The silicon transistor are more widely used than germanium transistors because :
- (a) they have smaller leakage current (b) they have better ability to dissipate heat
(c) they have smaller depletion layer (d) they have larger current carrying capacity
26. In CE mode of transistor, the most noticeable effect of a small increase in temperature is :
- (a) the increase in output resistance (b) the increase in leakage current I_{CEO}
(c) the decrease in current gain (d) the increase in ac current gain
27. A BJT is said to be operating in the saturation region if :
- (a) Both junctions are reverse biased
(b) Base – emitter junction is reverse biased and base collector junction is forward biased
(c) Base – emitter junction is forward biased and base – collector junction reverse biased
(d) Both the junctions are forward biased
28. The Early – Effect in a bipolar junction transistor is caused by :
- (a) Fast – turn – on. (b) Fast – turn – off.
(c) Large collector – base reverse bias. (d) Large emitter – base forward bias.
29. The pinch off voltage for a n – channel JFET is 4 V, when $V_{GS} = 1\ \text{V}$, the pinch – off occurs for V_{DS} equal to :
- (a) 3 V (b) 5 V
(c) 4 V (d) 1 V
30. When the gate – to – source voltage (V_{GS}) of a MOSFET with threshold voltage of 400 mV, working in saturation is 900 mV, the drain current is observed to be 1 mA. Neglecting the channel width modulation effect and assuming that the MOSFET is operating at saturation, the drain current for an applied V_{GS} of 1400 mV is :
- (a) 0.5 mA (b) 2.0 mA
(c) 3.5 mA (d) 4.0 mA

31. In a MOSFET operating in the saturation region, the channel length modulation effect causes :
- (a) An increase in the gate – source capacitance
 - (b) A decrease in the transconductance
 - (c) A decrease in the unity – gain cut – off frequency
 - (d) A decrease in the output resistance

32. Consider the following waveform



The equation for $x(t)$ is :

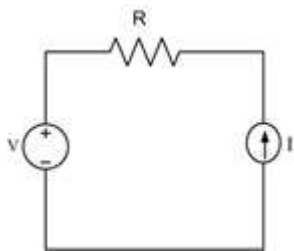
- (a) $u(t-1) - u(t-2) - u(t-3) - u(t-4)$
 - (b) $u(t-1) + u(t-2) - u(t-3) - u(t-4)$
 - (c) $u(t-1) + u(t-2) + u(t-3) - u(t-4)$
 - (d) $u(t-1) - u(t-2) + u(t-3) + u(t-4)$
33. A discrete time linear shift invariant system has an impulse response $h[n]$ with $h[0] = 1$, $h[1] = -1$, $h[2] = 2$ and 0 otherwise. The system is given an input sequence $x[n]$ with $x[0] = x[2] = 1$ and 0 otherwise. The number of non-zero samples in the output sequence $y[n]$, and the value of $y[1]$ are respectively,
- (a) 5, 3
 - (b) 6, 3
 - (c) 2, 6
 - (d) 5, -1
34. The system is defined by its impulse $h(n) = e^n u(n-2)$ is :
- (a) Unstable and anti-causal
 - (b) Unstable and causal
 - (c) Stable and Causal
 - (d) Stable and non-causal

35. If the Laplace transform of a signal is $Y(S) = \frac{1}{S(S-1)}$. Its final value is :

- (a) 1
 - (b) -1
 - (c) 0
 - (d) ∞
36. A discrete time system is stable if all the roots of the characteristics equation lie :
- (a) Outside the circle of unit radius
 - (b) Within the circle of unit radius
 - (c) Outside the circle of radius equal to 3-units
 - (d) On the circle of infinite radius.
37. The convolution of $x(t)$ and $h(t)$ is given by $y(t) = \int_{-\infty}^{\infty} x(\tau)h(t-\tau)$, then :
- (a) Both $x(t)$ and $h(t)$ are causal
 - (b) Both $x(t)$ and $h(t)$ are non-causal
 - (c) $x(t)$ is causal and $h(t)$ is non-causal
 - (d) $x(t)$ is non-causal and $h(t)$ is causal
38. The Fourier transform of a conjugate symmetric function is always :
- (a) Imaginary
 - (b) Conjugate antisymmetric
 - (c) Real
 - (d) Conjugate symmetric

39. The frequency spectrum indicates :
- (a) The relative phase of each frequency component
 - (b) The relative magnitude of each frequency component
 - (c) The relative frequency of each frequency component
 - (d) None of these
40. The nodal method of circuit analysis is based on :
- (a) KVL and Ohm's law
 - (b) KCL and Ohm's law
 - (c) KVL and KCL
 - (d) KVL, KCL and Ohm's law
41. The rms value of the voltage defined by $v(t) = 5 + 5 \sin\left(314t + \frac{\pi}{6}\right)$ is :
- (a) 5 V
 - (b) 2.5 V
 - (c) 6.12 V
 - (d) 10 V
42. For maximum power transfer between two cascaded sections of an electrical network, the relationship between the output impedance Z_1 of the first section to the input impedance Z_2 of the second section is:
- (a) $Z_2 = Z_1$
 - (b) $Z_2 = -Z_1$
 - (c) $Z_2 = Z_1^*$
 - (d) $Z_2 = -Z_1^*$
43. Norton's theorem states that a complex network connected to a load can be replaced with an equivalent impedance :
- (a) In series with a current source
 - (b) In parallel with a current source
 - (c) In series with a voltage source
 - (d) In parallel with a current source
44. The transient response occurs :
- (a) Only in resistive circuits
 - (b) Only in capacitive circuits
 - (c) Only in inductive circuits
 - (d) Both in capacitive and inductive circuits
45. Transient current of an RLC circuit is oscillatory when :
- (a) $R = 2\sqrt{L/C}$
 - (b) $R < 2\sqrt{L/C}$
 - (c) $R = 0$
 - (d) $R > 2\sqrt{L/C}$
46. A two-port network is reciprocal if and only if:
- (a) $Z_{11} = Z_{22}$
 - (b) $Y_{12} = Y_{21}$
 - (c) $BC - AD = -I$
 - (d) $h_{12} = h_{21}$
47. A certain series resonant circuit has a bandwidth of 1000 Hz. If the existing coil is replaced by a coil with low Q, what happens to the bandwidth?
- (a) Bandwidth will increase
 - (b) Bandwidth becomes zero
 - (c) Bandwidth will decrease
 - (d) Bandwidth remains the same
48. The dual of a parallel R-C circuit is a :
- (a) Series R-C circuit
 - (b) Series R-L circuit
 - (c) Parallel R-C circuit
 - (d) Parallel R-L circuit
49. Superposition theorem is not applicable for :
- (a) Voltage calculations
 - (b) Bilateral elements
 - (c) Passive elements
 - (d) Power calculations

50. For the network shown in the figure, what is the voltage across the current source I?



- (a) $V - RI$
- (b) $V + RI$
- (c) Zero
- (d) $RI - V$

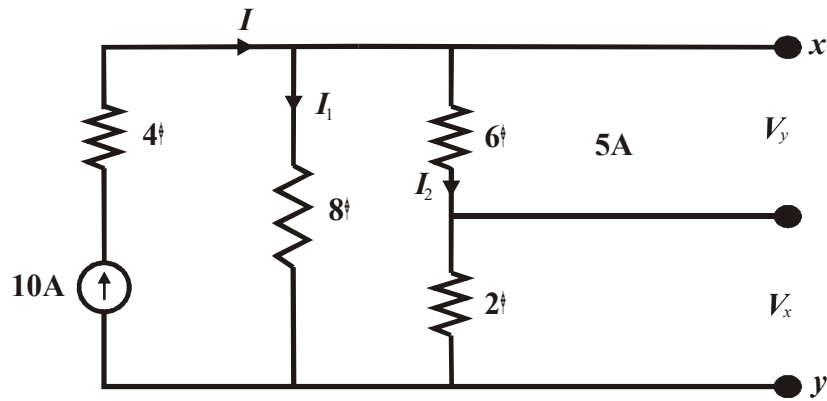
SECTION - B (Short answer type question)
(100 Marks)

All questions carry equal marks of 5 each.

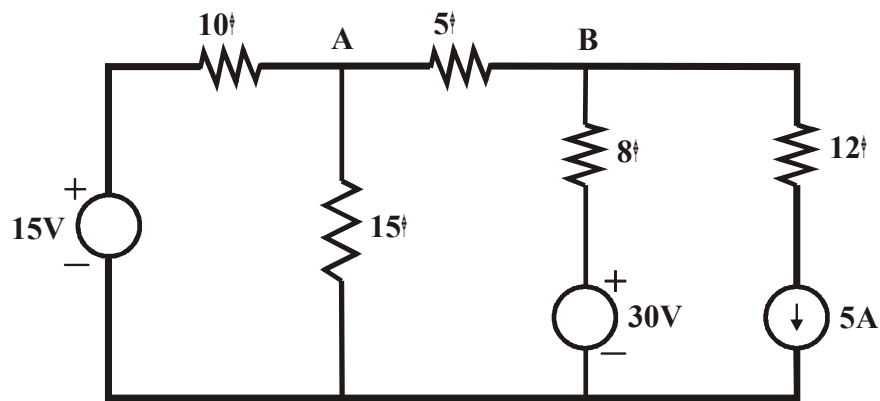
This Section should be answered only on the Answer Sheet provided.

1. What is the difference between active and passive devices? Why it is necessary to connect an electrolytic capacitor in a circuit with correct polarity?
2. Define the following term associated with P-N junction diode
 - (a) Breakdown voltage
 - (b) Knee Voltage
 - (c) Maximum forward current
 - (d) Peak inverse voltage
 - (e) Maximum Power rating
3. Explain the working of Zener diode as a shunt regulator.
4. What is photo diode? With proper characteristics curves and relevant diagrams explain the operation of photo diode. Explain the concept of photo conductivity.
5. With neat circuit diagram explain the operation of SCR as a half wave rectifier and full wave rectifier.
6. Define the following (a) Periodic and non-periodic signal (b) even and odd signal (c) causal and non-causal system (d) time variant and time invariant system (e) energy and power signal.
7. Determine the inverse Laplace transform of $X(s) = \frac{1}{(s+2)(s^2+s+1)}$.
8. State and prove the final value theorem with regard to Z transform.
9. Describe the Hall Effect and explain its relation to mechanical force exerted by magnetic field on conduction.
10. Explain the phenomenon of superconductivity. Briefly explain its salient features, mechanism and applications.
11. With the help of energy band diagram, distinguish between insulators, conductors and semiconductors.
12. Explain the effect of temperature on V-I characteristics of a diode.

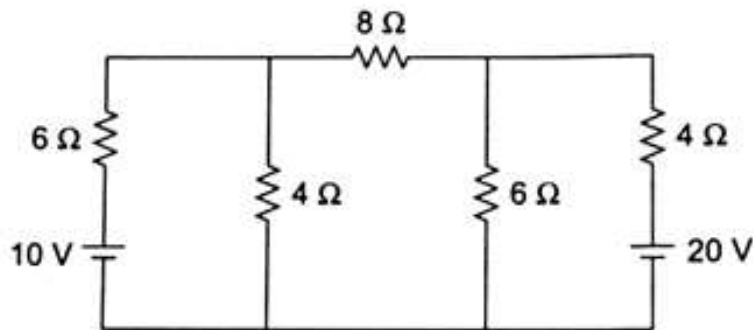
13. Determine the current in all the resistors in the circuit given below. Also find the voltage across each element and show the power delivered by the source is equal to the power dissipated by the resistors.



14. Find the voltage across the 5W resistor in the figure given below by using Superposition theorem.

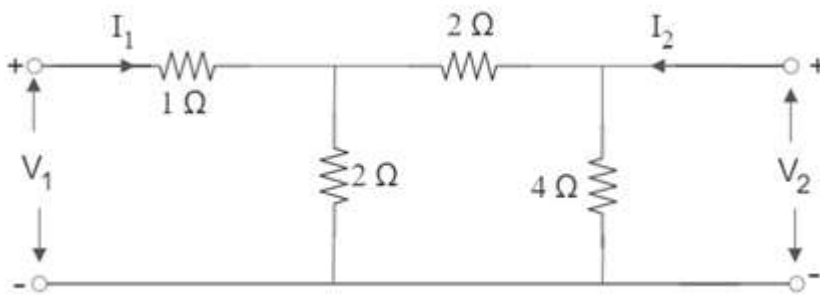


15. State and explain Thevenin's theorem.
 16. For the network shown in the figure below, obtain branch voltages using KCL equations on node basis.



17. Write down the following properties associated with continuous time convolution operation
- | | |
|---------------------------------------|---------------------------|
| (a) commutative property | (b) distributive property |
| (c) associative property | (d) shift property |
| (e) convolution with impulse property | |
18. Find the resonance frequency of practical parallel R-L-C circuit.
 19. Explain series and parallel resonance with necessary circuit diagram.

20. Find the Y parameters



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