

MIZORAM PUBLIC SERVICE COMMISSION

TECHNICAL COMPETITIVE EXAMINATIONS FOR RECRUITMENT TO JUNIOR GRADE OF MIZORAM ENGINEERING SERVICE UNDER POWER & ELECTRICITY DEPARTMENT, NOVEMBER, 2015.

ELECTRONICS & COMMUNICATION ENGINEERING PAPER - I

Time Allowed : 3 hours

Full Marks : 200

Attempt all questions.

Part A - Objective Type Questions (100 Marks)

All questions carry equal marks of 2 each.

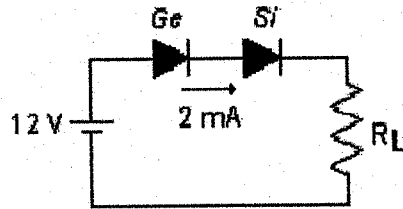
This Part should be answered only on the OMR Response Sheet provided.

1. Ferromagnetic materials are those which
 - (a) cannot be polarised
 - (b) have a permanent polarisation
 - (c) have α_e equal to zero
 - (d) have μ_p equal to zero
2. The law $J = \sigma E$, where J is current density, σ is electrical conductivity and E is electric field strength is
 - (a) Ohm's law
 - (b) Gauss's law
 - (c) Bio-Savart's law
 - (d) Ampere's law
3. When a potential is applied across an intrinsic semiconductor, holes flow
 - (a) towards positive terminal
 - (b) away from positive terminal
 - (c) in the external circuit only
 - (d) None of these
4. If the diameter of a wire is doubled, its current carrying capacity becomes
 - (a) One fourth
 - (b) Half
 - (c) Twice
 - (d) Four times
5. Which of these has lowest dielectric strength?
 - (a) Dry air
 - (b) Wet air
 - (c) Cotton
 - (d) Paper
6. Which of the following is a passive component?
 - (a) Semi-conductor device
 - (b) Vacuum tube device
 - (c) Capacitors
 - (d) All of these
7. One eV is equal to _____ J.
 - (a) 6.02×10^{23}
 - (b) 1.6×10^{-19}
 - (c) 6.25×10^{18}
 - (d) 1.66×10^{-24}
8. In what state is a silicon diode if the voltage drop across it is about 0.7V?
 - (a) No bias
 - (b) Forward bias
 - (c) Reverse bias
 - (d) Zener region

9. An open circuit can have any voltage across its terminals, but the current is always _____.

- (a) 5A
- (b) 0A
- (c) 1A
- (d) ∞

10. Determine the value of the load resistor.



- (a) $R_L = 5 \text{ k}\Omega$
- (b) $R_L = 5.5 \text{ k}\Omega$
- (c) $R_L = 6 \text{ k}\Omega$
- (d) None of these

11. In which region are both the collector-base and base-emitter junctions forward-biased?

- (a) Active
- (b) Cutoff
- (c) Saturation
- (d) All of these

12. In a transistor-switching network, the operating point switches from _____ to _____ regions along the load line.

- (a) cutoff, active
- (b) cutoff, saturation
- (c) active, saturation
- (d) none of these

13. Three resistances of 15Ω , 10Ω and 3Ω are connected in parallel. The overall resistance is

- (a) Less than 3Ω
- (b) Between 15 and 10Ω
- (c) Between 10 and 3Ω
- (d) More than 3Ω

14. An ideal current source has

- (a) Infinite source resistance
- (b) Zero source resistance
- (c) Large value of source resistance
- (d) Finite value of source resistance

15. Two coupled coils with self inductances of 4mH and 16 mH are connected in series. The maximum possible value of inductances can be

- (a) 36 mH
- (b) 20 mH
- (c) 28 mH
- (d) 64 mH

16. Norton's equivalent circuit

- (a) Is same as Thevenin's circuit
- (b) Has no relation with Thevenin's circuit
- (c) Is dual of Thevenin's circuit
- (d) Is reciprocal of Thevenin's circuit

17. The Fourier transform (FT) of a function $x(t)$ is $X(f)$. The FT of $dx(t)/dt$ will be

- (a) $dX(f)/df$
- (b) $2j\pi fX(f)$
- (c) $jfX(f)$
- (d) $X(f)/(jf)$

18. Given a unit step function $u(t)$, its time-derivative is

- (a) a unit impulse
- (b) another step function
- (c) a unit ramp function
- (d) a sine function

19. z-transform converts convolution of time-signals to

- (a) addition
- (b) subtraction
- (c) multiplication
- (d) division

20. A band pass signal extends from 1 KHz to 2 KHz. The minimum sampling frequency needed to retain all information in the sampled signal is
- (a) 1 KHz (b) 2 KHz
(c) 3 KHz (d) 4 KHz
21. When two honest coins are simultaneously tossed, the probability of two heads on any given trial is
- (a) 1 (b) 3/4
(c) 1/2 (d) 1/4
22. For insulators, the forbidden gap is of the order of
- (a) 5 eV (b) 1 eV
(c) 0.1 eV (d) zero
23. The transition temperature of superconducting material is changed by which one of the following?
- (a) Electric Field (b) Magnetic Field
(c) Mechanical Stress (d) None of these
24. Which of the following materials are piezoelectric?
- (a) mica & quartz (b) mica & barium titanate
(c) mica & diamond (d) quartz & barium titanate
25. In an intrinsic semiconductor, the number of electrons is equal to the number of holes at which temperature?
- (a) 0°K (b) 0°C
(c) high temperature (d) at all temperature
26. The nature of crystal binding in Germanium is
- (a) ionic (b) metallic
(c) covalent (d) Van-der-wall type
27. 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%
28. Under low level injection assumption, the injected minority carrier current for an extrinsic semiconductor is essentially the
- (a) diffusion current (b) drift current
(c) recombination current (d) induced current
29. Which of the following is the poorest electrical conductor?
- (a) steel (b) carbon
(c) copper (d) aluminium
30. The color code of $1K\Omega$ resistance is
- (a) black, brown, red (b) red, brown, brown
(c) brown, black, red (d) black, black, red
31. Avalanche breakdown is primarily dependent on the phenomenon of
- (a) collision (b) doping
(c) ionisation (d) recombination

32. In a JFET drain current is maximum when V_{GS} is
(a) zero (b) negative
(c) positive (d) $V_{pinch\ off}$
33. Which of the following is a periodic signal?
(a) $Au(t)$ (b) Ae^{-jbt}
(c) Ae^{bt} (d) At
34. Which of the following responses of an LTI system does not depend on initial conditions?
(a) natural response (b) free response
(c) forced response (d) total response
35. The transfer function of a continuous time system is described by
 $Y(s)/X(s) = (s^4 + 4s + 3)/(s^5 + 4s^3 + 1)$
The number of state variables in the state model of the system is
(a) 1 (b) 2
(c) 4 (d) 5
36. The process of conversion of continuous time signal into discrete time signal is known as
(a) aliasing (b) sampling
(c) convolution (d) none of these
37. Sectioned convolution is performed if one of the sequences is very much larger than the other in order to overcome
(a) long delay in getting output (b) require larger memory
(c) both (a) & (b) (d) none of these
38. A network contains linear resistors and ideal voltage sources. If values of all the resistors are doubled then the voltage across each resistor is
(a) halved (b) doubled
(c) increased (d) remains same
39. The r.m.s. value of half wave rectified current is 50A. Its r.m.s. value for full wave rectification would be
(a) 100A (b) $(50/\pi)A$
(c) $(100/\pi)A$ (d) 70.7A
40. The power in a series RLC circuit will be half of that at resonance when the magnitude of the current is equal to
(a) $V/2R$ (b) $V/\sqrt{3R}$
(c) $V/\sqrt{2R}$ (d) $\sqrt{2V/R}$
41. A network has 7 nodes and 5 independent loops. The total number of branches in the network is
(a) 13 (b) 12
(c) 11 (d) 10
42. For a two port network to be reciprocal, required condition is
(a) $Z_{11} = Z_{22}$ (b) $Y_{12} = Y_{21}$
(c) $h_{21} = h_{12}$ (d) $AD - BC = 0$

43. The driving-point impedance of a network is given by $Z(s) = (s^2 + 2s + 6) / s(s + 3)$

Then the number of energy storage elements present in the network is

- (a) 1
- (b) 2
- (c) 3
- (d) 4

44. If a sample of germanium and a sample of silicon have the same impurity density and are kept at room temperature

- (a) both will have equal value of resistivity
- (b) both will have equal negative resistivity
- (c) resistivity of silicon will be higher than that of germanium
- (d) resistivity of germanium will be higher than that of silicon

45. Which of the following are donor impurities?

- 1. Gold
 - 2. Phosphorus
 - 3. Boron
 - 4. Antimony
 - 5. Arsenic
 - 6. Indium
- (a) 2, 4, 5
 - (b) 3, 4, 5, 6
 - (c) 1, 2, 4, 6
 - (d) 1, 2, 3

46. The power dissipation in a transistor is the product of

- (a) emitter current and emitter to base voltage
- (b) emitter current and collector to emitter voltage
- (c) collector current and collector to emitter voltage
- (d) none of these

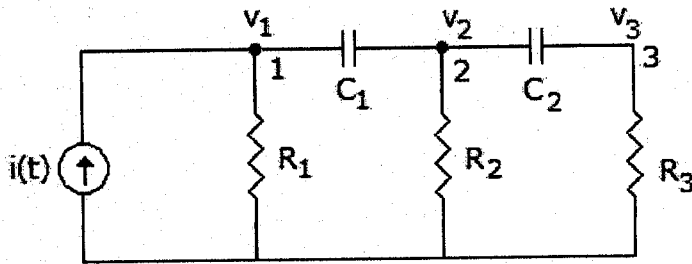
47. What is the stability of system in $H(Z) = \frac{Z(3Z - 4)}{(Z - 0.4)(Z - 2)}$

- (a) system is stable
- (b) unstable
- (c) stable at 0.4
- (d) can't say

48. A signal $m(t)$ is multiplied by a sinusoidal waveform of frequency f_c such that $v(t) = m(t) \cos 2\pi f_c t$. If Fourier transform of $m(t)$ is $M(f)$, Fourier transform of $v(t)$ will be

- (a) $0.5 M(f + f_c)$
- (b) $0.5 M(f - f_c)$
- (c) $0.5 M(f + f_c) + 0.5 M(f - f_c)$
- (d) $0.5 M(f - f_c) + 0.5 M(f - f_c)$

49. For node 1 in figure, KCL equation is



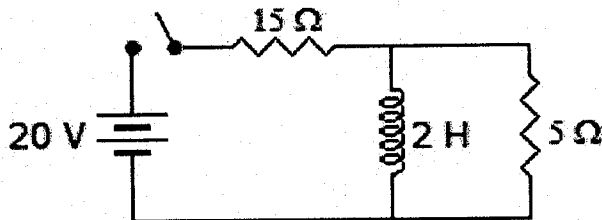
(a) $i(t) = \frac{V_1}{R_1} + C_1 \frac{d}{dt}(V_2 + V_1)$

(b) $i(t) = -\frac{V_1}{R_1} + C_1 \frac{d}{dt}(V_1 - V_2)$

(c) $i(t) = \frac{V_1}{R_1} + C_1 \frac{d}{dt}(V_1 - V_2)$

(d) None of these

50. In figure, the current supplied by battery immediately after switching on the circuit is



(a) 0

(b) 1A

(c) 4A

(d) 10A

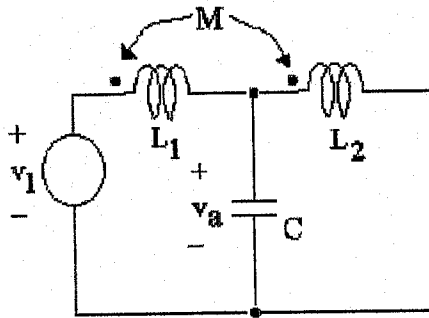
Part B - Short Answer Questions (100 Marks)

All questions carry equal marks of 5 each.

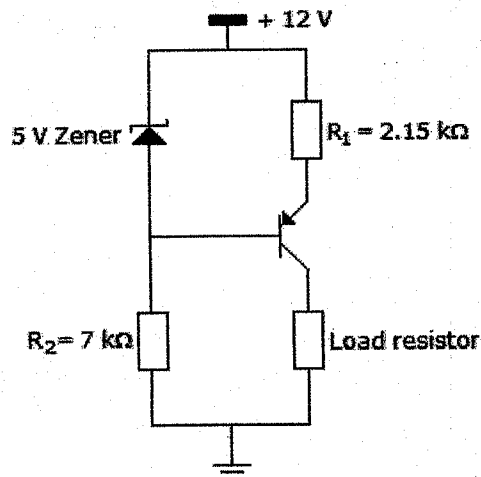
This Part should be answered only on the Answer Booklet provided.

1. Differentiate between n and p type semiconductors.
2. Distinguish between ferromagnetic, paramagnetic and diamagnetic materials, mentioning at least one example of each.
3. What is super conductivity? What are the characteristics of super conducting material?
4. Draw a figure to show the output V-I characteristic curves of a BJT in CE configuration. Indicate thereon, the saturation, active and cut off regions.
5. A voltage source V1 whose internal resistance is R1 delivers power to a load $R_2 + jX_2$ in which X_2 is fixed but R_2 is variable. Find the value of R_2 at which the power delivered to the load is a maximum.

6. In the circuit shown in Fig. below, $v_1(t) = 2 \cos t$, $C = 1F$, $L_1 = L_2 = 1H$ and $M = 0.25 H$. Find the voltage $v_a(t)$.



7. State and initial and final value theorem.
8. Find the Laplace transform of $t \sin \omega_0 t u(t)$.
9. Explain about depletion layer in connection with P-N junction. What is depletion layer capacitance?
10. Explain the terms (a) Valence, (b) Work function, (c) contact potential with respect to metal or metal junction.
11. Define cross correlation and autocorrelation then explain in brief with suitable examples.
12. Two wires A and B of same material and length L and $2L$ have radius r and $2r$ respectively. What will be the ratio of their specific resistances?
13. Derive relation for maximum power transfer from a voltage source to the load. Also find the expression for maximum power transferred.
14. Sketch the amplitude and phase response for the network function...
- $$F(s) = (s + 10) / (s - 10)$$
15. Explain zener breakdown and avalanche breakdown.
16. What do you mean by enhancement mode and depletion mode MOSFET?
17. The figure shown below is designed to act as a constant current source across the load resistor. The β of transistor is 50. What is the value of load current?

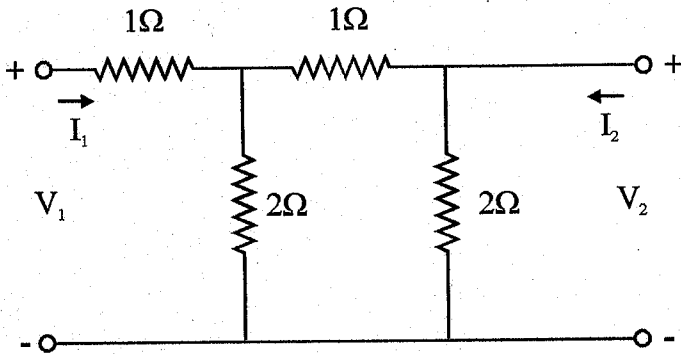


18. With regard to Fourier series representation, justify the following statements:

- (i) Odd functions have only sine terms.
- (ii) Even functions have no sine terms.

19. State Thevenin's theorem & Superposition theorem. Also prove these.

20. Find z parameters for the following network.



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