

**Material Science OLD IES in EEE stream questions**

**IES-2001**

1. Total number of electrons that can be accommodated in various electron states in a valence band of a given solid is equal to

- a. atomic number of the solid
- b. half the number of atoms in the solid
- c. the number of atoms in the solid
- d. twice the number of atoms in the solid

2. Consider the following properties pertaining to an alloy used as a precision resistor.

- 1. Uniform resistance
- 2. Stable resistance
- 3. Zero or low temperature coefficient of resistivity

Which of these properties are desirable?

- a. 1, 2 and 3
- b. 1 and 2
- c. 1 and 3
- d. 2 and 3

3. By inserting a slab of dielectric material between the plates of a parallel plate capacitor, the energy stored in the capacitor has increased three times.

The dielectric constant of the material is

- a. 9
- b. 3
- c. 1/3
- d. 1/9

4. When a dielectric is subjected to an alternating electric field of angular frequency ' $\omega$ ', its power loss is proportional to

- a.  $\omega$
- b.  $\omega^2$
- c.  $1/\omega$
- d.  $1/\omega^2$

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5. For a given dielectric, with increase in temperature the ionic polarizability  
a. increases                      b. decreases  
c. remains same                  d. fluctuates

6. A piezoelectric crystal has an Young's modulus of 130 GPa. The uniaxial stress that must be applied to increase its polarization from 500 to 510  $\text{cm}^{-2}$  is  
a. 1.171 GPa                      b. 1.182 GPa  
c. 2.6 GPa                         d. 2.55 GPa

7. 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.  $1/T^3$

8. In a conductor of size 20mm x 10mm x 10mm, the wavelength of the slowest moving free electron is  
a. 5 mm                              b. 10 mm  
c. 20 mm                            d. 40 mm

9. The conductivity of a conducting material on being subject to critical magnetic field changes to  
a. normal state  
b. unstable state  
c. temperature-independent state  
d. temperature-dependent state

10. A large value of the exchange interaction energy in a ferromagnetic material implies

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- a. Large saturation magnetization
- b. High Curie temperature
- c. High melting point
- d. Large diamagnetic susceptibility

11. Which one of the following pairs is not correct matched?

- a. Copper : Diamagnetic
- b. Sodium : Anti ferromagnetic
- c. Iron : Ferromagnetic
- d. Ferrite : Ferrimagnetic

12. Ferromagnetic behaviour is shown by those transition metals where the ratio of the atomic diameter to 3d orbital diameter is

- a. in the range of 0.5 to 1
- b. in the range of 1 to 1.5
- c. in the range of 1.5 to 2
- d. greater than 2

13. Ferrites can be considered as mixed oxides of metals A and B having inverse spinel structure. Their formula can be written as

- a.  $ABO_2$                       b.  $A_2BO_2$
- c.  $AB_2O_3$                       d.  $AB_2O_4$

14. Match List-I (Magnetic materials) with List-II (Main applications) and select the correct answer:

List-I

List-II

- |                  |                      |
|------------------|----------------------|
| a. Ni-Zn ferrite | 1. Recording head    |
| b. Co-Sm alloy   | 2. Permanent Magnets |

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- |                        |                            |
|------------------------|----------------------------|
| c. Yttrium iron Garnet | 3. Audio & TV transformers |
| d. Mg-Zn ferrite       | 4. Memory cores            |
|                        | 5. Microwave isolators     |

Codes:

	A	B	C	D
a.	3	4	5	2
b.	1	2	3	4
c.	3	2	5	4
d.	1	4	3	2

15. For a semiconductor, which one of the following statements is not correct?
- When an electron and a hole recombine, energy must be liberated
  - Electrons in the conduction band can acquire a net acceleration from a field because there are empty energy levels available.
  - An electron in the valence band cannot be accelerated by the field unless there are empty energy levels available
  - Holes cannot be accelerated by the field unless there are empty energy levels available.

16. Consider the following statement:

Extrinsic semiconductors show high electrical conductivity because the impurities are

- of high conductivity
- highly mobile
- highly charged

Which of these statements are not correct?

- |            |              |
|------------|--------------|
| a. 1 and 2 | b. 2 and 3   |
| c. 1 and 3 | d. 1,2 and 3 |

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17. Match List-I with List-II and select the correct answer:

List-I

- a. Ga-As
- b. Nichrome
- c. Quartz
- d. Si

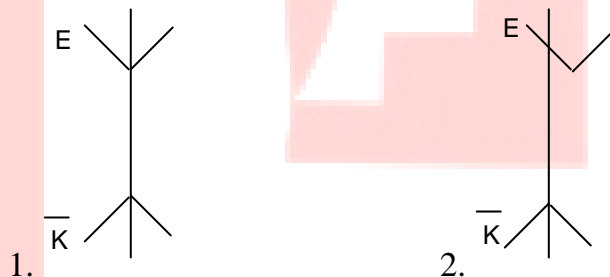
List-II

- 1. Integrated Circuit
- 2. Laser
- 3. Busbar
- 4. Heating element
- 5. Oscillator

Codes:

	A	B	C	D
a.	2	4	5	1
b.	1	5	3	2
c.	2	5	3	1
d.	1	4	5	2

18. Consider the following energy-momentum (E-k) curves labeled as 1, 2, 3 and 4 of different semiconductors:



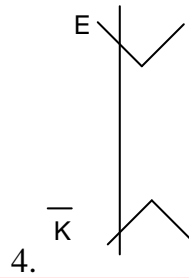
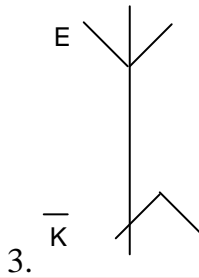
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Sets of direct and indirect gap curves are respectively

- a. (1, 2) and (3, 4)                      b. (1,4) and (2, 3)  
c. (1, 3) and (2, 4)                      d. (2, 3) and (1, 4)

19. Match List-I (p-n junction devices) with List-II (Application) and select the correct answer:

List-I

- a. Zener Diode  
b. Pin Diode  
c. Tunnel Diode  
d. Varactor Diode

List-II

1. Fast switching circuits  
2. Microwave switches  
3. Local oscillators for radars  
4. Frequency converters  
5. Voltage regulators

Codes:

- |    | A | B | C | D |
|----|---|---|---|---|
| a. | 5 | 2 | 1 | 4 |
| b. | 1 | 2 | 5 | 4 |
| c. | 5 | 3 | 1 | 2 |
| d. | 1 | 3 | 5 | 2 |

**IES-2002**

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20. 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%

21. which of the following has the greatest mobility?

- a. Positive ion              b. Negative ion  
c. Electron                 d. Hole

22. Match List-I (Type of the material) with List-II (Name of the material) and select the correct answer:

List-I

List-II

- |                           |                                    |
|---------------------------|------------------------------------|
| a. Ferroelectric material | 1. Permalloy                       |
| b. Piezoelectric material | 2. BaTiO <sub>3</sub><br>ceramic   |
| c. Soft magnetic material | 3. KH <sub>2</sub> PO <sub>4</sub> |
| d. Hard magnetic material | 4. Tungsten steel                  |

Codes:

- |    | A | B | C | D |
|----|---|---|---|---|
| a. | 3 | 2 | 1 | 4 |
| b. | 1 | 4 | 3 | 2 |
| c. | 3 | 4 | 1 | 2 |
| d. | 1 | 2 | 3 | 4 |

23. On the application of the field  $\vec{E}$ , the modified field due to polarization P in solids and liquids having cubic symmetry is given by

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a.  $\bar{E} + \frac{\bar{P}}{\epsilon_n}$

b.  $\bar{E} - \frac{\bar{P}}{\epsilon_0}$

c.  $\bar{E} + \frac{\bar{P}}{3\epsilon_0}$

d.  $\bar{E} - \frac{\bar{P}}{3\epsilon_0}$

24. The complex dielectric constant of a material is given by the expression:

$$\epsilon = \epsilon' - j \epsilon''$$

If a parallel plate capacitor with area 'A' and separation 'd' is formed with this material as a dielectric the loss factor will be

a.  $(A \epsilon') / (d \epsilon'')$

b.  $\epsilon'' / \epsilon'$

c.  $\tan^{-1} [(A \epsilon') / (d \epsilon'')]$

d.  $\tan^{-1} [(d \epsilon'') / (A \epsilon')]$

25. At optical frequencies, the major contribution to the total polarization comes from

a. space charge polarization

b. orientational polarization

c. ionic polarization

d. electronic polarization

26. Which of the following insulating materials has the least affinity for moisture?

a. Cotton

b. Paper

c. Asbestos

d. Mica

27. Which of the following statements is not True?

a. Superconductors show perfect diamagnetism

b. Superconductors have almost zero resistivity

c. The external magnetic field has no effect on superconductors

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d. Entropy increases on going from superconducting state to normal state

28. The transition temperature of Mercury at which it becomes superconductive is

- a.  $4.12^{\circ}\text{F}$                       b.  $4.12^{\circ}\text{C}$   
c.  $4.12\text{ K}$                               d.  $41.2\text{ K}$

29. de Broglie wavelength associated with a material particle is

- a. inversely proportional to its energy  
b. directly proportional to its momentum  
c. directly proportional to its energy  
d. inversely proportional to its momentum

30. Which one of the following materials cannot be used for permanent magnets?

- a. Alnico                                  b. Barium Ferrite  
c. Carbon-Steel                      d. Iron-Cobalt alloy

31. Upto about 4% silica is added in iron to be used as a soft magnetic material. The major reason for this is to

- a. increase permeability of the material  
b. increase electrical resistivity of the material  
c. increase the coercive force  
d. increase the saturation flux density

32. Which of the following is piezoelectric material?

- a. Quartz                                  b. Silica sand  
c. Corundum                              d. Polystyrene

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Direction: The following 4 items consist of two statements one labeled as 'Assertion A' and the other labeled as 'Reason R'. You are to examine these two statements carefully and decide if the Assertion A and the Reason R are individually true and if so, whether the Reason is a correct explanation of the Assertion. Select your answers to these items using the codes given below and mark your answer sheet accordingly.

- a. Both A and R are true and R is the correct explanation of A
- b. Both A and R are true but R is not the correct explanation of A
- c. A is true but R is false
- d. A is false but R is true

33. Assertion (A): A doped semiconductor will behave as a perfect insulator at zero Kelvin but its electrical conductivity will rise if the temperature is slowly increased above zero Kelvin.

Reason (R): The rise in electrical conductivity is mainly due to increased ionization as the temperature is raised above zero Kelvin.

#### **IES-2003**

34. Assertion (A): Energy released when an electron jumps from a higher to a lower level is usually in the form of photons.

Reason (R): Energy released when an electron jumps from a higher to a lower level is absorbed by the nucleus.

35. Assertion (A): Lepidolite type mica is unsuitable for electric insulation.

Reason (R): Lepidolite is hard and brittle.

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36. Assertion (A): Glazing is done on ceramic insulators to make the surface smooth and non absorbent.

Reason (R): Moisture from the atmosphere can collect on the surface discontinuities on a ceramic and result in electrical breakdown.

37. The forbidden energy gap in silicon at 300 K is

- a. 1.41 eV
- b. 1.1 eV
- c. 0.785 e V
- d. 0.72 e V

38. With an increase in temperature the Fermi level in an intrinsic semiconductor

- a. Moves closer to the conduction band edge
- b. Moves closer to the valence band edge
- c. Moves into the conduction band
- d. Remains at the centre of the forbidden gap

39. Which one of the following is not true for Sulphur hexafluoride gas?

- a. It is electronegative in nature
- b. It has high dielectric-strength
- c. It is non-toxic
- d. It is highly inflammable

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

- a. Polystyrene
- b. Marble
- c. Cotton
- d. Transformer oil

41. The losses in a dielectric subject to an alternating electric field are determined by

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- a. Real part of the complex dielectric constant
- b. Imaginary part of the complex dielectric constant
- c. Absolute value of the complex dielectric constant
- d. Ratio of the magnitude of the real and imaginary parts of the complex dielectric constant.

42. In a solid or liquid dielectric with externally applied electric field, as the interatomic distance increases the internal field  $E_i$ ,

- a. Increases
- b. Decreases
- c. Remains unaltered
- d. Increases or decreases based on temperature

43. According to Wiedemann-Franz law the ratio of thermal conductivity to electrical conductivity of a conductor of

- a. Independent of temperature
- b. Directly proportional to temperature
- c. inversely proportional to temperature
- d. Inversely proportional to square of temperature

44. Which one of the following statements is correct for four-point probe method of determining resistivity?

- a. The sample must be extrinsic
- b. The current source is connected to the two inner probes
- c. One probe point must inject minority carriers
- d. Current flow only in a small area of the sample

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45. The average drift velocity  $V_d$  of electrons in a metal is related to electric field  $E$  and collision time  $T$  as

- a.  $V_d = Q_e ET/m_e$       b.  $V_d = m_e Q_e T$   
c.  $V_d = m_e Q_e T/2E$       d.  $V_d = Q_e Et/2 m_e$

46. Susceptibility of a diamagnetic material is

1. Negative
2. Positive
3. Dependent on the temperature
4. Independent of the temperature

Select the correct answer using the codes given below:

- a. 1 and 3      b. 2 and 4  
c. 1 and 4      d. 2 and 3

47. Match List-I (Magnetic Materials) with List-II (Applications) and select the correct answer:

List-I

- a. Silicon Steel
- b. Ferrite
- c. Alnico

List-II

1. Current transformer
2. Power transformer
3. Permanent magnet
4. High frequency transformer

Codes:

- |    | A | B | C |
|----|---|---|---|
| a. | 1 | 2 | 3 |
| b. | 1 | 4 | 2 |
| c. | 2 | 1 | 4 |
| d. | 2 | 4 | 3 |

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48. The development of barrier potential in the depletion zone of a PN junction is consequent to

- a. Diffusion of majority carriers across junction
- b. Drift of minority carriers across junction
- c. Generation of minority carriers due to thermal energy
- d. Initial flow of conduction current

49. The current flow in a certain PN junction at room temperature 300 K is  $2 \times 10^{-7}$  A when a large reverse bias voltage is applied. The current flowing when a forward bias of 0.1 V is applied will be

a.  $2 \times 10^{-7} \exp \left[ \frac{1.6 \times 10^{-19} \times 0.1}{1.38 \times 10^{-23} \times 300} \right]$

b.  $2 \times 10^{-7} \times \left[ \frac{-1.6 \times 10^{-19} \times 0.1}{1.38 \times 10^{-23} \times 300} \right]$

c.  $2 \times 10^{-7} \exp \left[ \frac{-1.38 \times 10^{-23} \times 300}{1.6 \times 10^{-19} \times 0.1} \right]$

d.  $2 \times 10^{-7} \times \left[ \frac{1.38 \times 10^{-23} \times 300}{1.6 \times 10^{-19} \times 0.1} \right]$

50. On which of the following factors does the electrical conductivity of a semiconductor depend?

- 1. carrier concentration
- 2. carrier mobility
- 3. sign of the carriers

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Select the correct answer using the codes given below:

- a. 1 and 2                      b. 1 and 3  
c. 2 and 3                      d. 1, 2 and 3

51. An intrinsic semiconductor at a temperature absolute zero behaves like an insulator because of

- a. Non-availability of free electrons  
b. Non-recombination of electrons with holes  
c. Low drift velocity of free electrons  
d. Low (almost zero) electron energy

52. Consider the following statement:

$E_f^n$  and  $E_f^p$  are the energies of the Fermi levels on the n and p sides of p<sup>n</sup> junction diode, respectively. They will vary with applied bias as follows:

1.  $E_f^n = E_f^p$  with no bias applied
2.  $E_f^n$  increases and  $E_f^p$  decreases with forward bias.
3.  $E_f^n$  decreases and  $E_f^p$  increases with reverse bias.
4.  $E_f^n$  decrease and  $E_f^p$  increases with forward bias.
5.  $E_f^n$  increases and  $E_f^p$  decreases with reverse bias.

Select the correct answer using the codes given below:

- a. 1, 4 and 5                      b. 2 and 3  
c. 4 and 5                         d. 1, 2 and 3

53. Match List-I (Thyristor) with List-II (Symbols) and select the correct answer

List-I

List-II

- a. Silicon-controlled

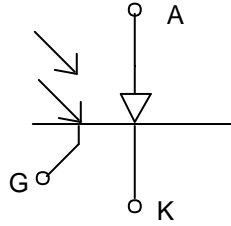
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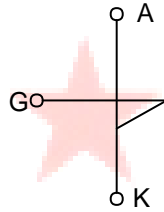
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rectified (SCR)

1.

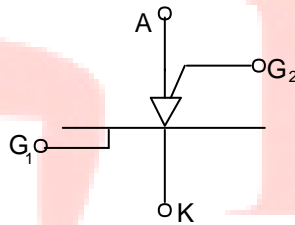
b. Silicon-controlled



switch (SCS)

2.

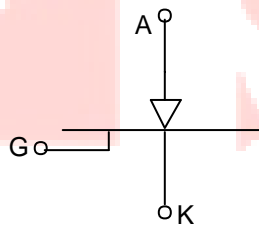
c. Silicon-unilateral



switch (SUS)

3.

d. Light activated



SCR (LASCR)

4.

Codes:

- |    | A | B | C | D |
|----|---|---|---|---|
| a. | 3 | 4 | 1 | 2 |
| b. | 4 | 3 | 1 | 2 |

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**Material Science OLD IES in EEE stream questions**

- c. 3      4      2      1  
d. 4      3      2      1

**IES-2004**

54. On which of the following factors does the value of critical current density in a superconductor depend?

- a. Temperature  
b. Applied magnetic field  
c. Temperature and applied magnetic field  
d. Silsbee's rule

55. Match List-I (Materials) with List-II (Equation/rule) and select the correct answer using the codes given below:

List-I

- a. Dielectric material  
b. Ferromagnetic  
c. Conductors  
d. Superconductor

List-II

1. Debye equation material  
2. Curie Weiss law material  
3. Matthiessen's rule  
4. Meissner effect

Codes:

- |    | A | B | C | D |
|----|---|---|---|---|
| a. | 3 | 4 | 1 | 2 |
| b. | 1 | 4 | 3 | 2 |
| c. | 3 | 2 | 1 | 4 |
| d. | 1 | 2 | 3 | 4 |

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56. A dielectric material has the real part of the dielectric constant ( $\epsilon'_r$ ) and 4 and its loss tangent is 0.004. What is the complex dielectric constant ( $\epsilon_r^*$ ) represented by?

- a.  $4 + j 0.016$                       b.  $4 - j 0.016$   
c.  $4 + j 0.001$                       d.  $4 - j. 0.001$

57. Match List-I with List-II and select the correct answer using the codes given below:

List-I

- a. Larmor frequency  
b. Bohr magneton  
c. Magnetic induction  
d. Curie-Weiss law

List-II

1.  $\chi = C/(T-\theta)$   
2.  $B = \mu_0 (H+M)$   
3.  $eh/4\pi m$   
4.  $eB/2 m$

Codes:

	A	B	C	D
a.	2	1	4	3
b.	2	3	4	1
c.	4	1	2	3
d.	4	3	2	1

58. Which one of the following statements is not correct?

- a. Vacuum can act as a dielectric material  
b. Piezoelectric materials can act as transducers  
c. Quartz crystal is a ferroelectric material  
d. The dielectric constant of dielectrics depends on the frequency of the applied field

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59. Which one of the following is the temperature below which certain material are anti ferromagnetic and above which they are paramagnetic?

- a. Curie temperature
- b. Neel temperature
- c. Transition temperature
- d. Weiss temperature

60. Match List-I (Type of the material) with List-II (Name of the material) and select the correct answer using the codes given below:

List-I

- a. Ferroelectric
- b. Soft magnetic
- c. Hard magnetic
- d. Semiconductor

List-II

- 1. Rochelle salt
- 2. Alnico
- 3. Permalloy
- 4. Ga As

Codes:

	A	B	C	D
a.	3	1	2	4
b.	1	3	2	4
c.	3	1	4	2
d.	1	3	4	2

61. Which one of the following statements is correct? A ferrite core has lower specific eddy current loss compared to an iron core because the iron core has

- a. higher electrical resistance
- b. lower electrical resistance
- c. higher permeability
- d. lower permeability

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62. In which one of the following ways can the Hall voltage across an impurity semiconductor crystal be increased?

- a. By increasing the thickness of the crystal
- b. By increasing the concentration of impurity atoms in the crystal
- c. By increasing the width of the crystal
- d. By increasing the current flowing through the crystal

63. Which one of the following statements is correct? The Hall coefficient of an intrinsic semiconductor is

- a. positive
- b. negative
- c. zero
- d. infinite

Direction: The following 4 items consist of two statements one labeled as 'Assertion A' and the other labeled as 'Reason R'. You are to examine these two statements carefully and decide if the Assertion A and the Reason R are individually true and if so, whether the Reason is a correct explanation of the Assertion. Select your answers to these items using the codes given below and mark your answer sheet accordingly.

- a. Both A and R are true and R is the correct explanation of A
- b. Both A and R are true but R is not the correct explanation of A
- c. A is true but R is false
- d. A is false but R is true

64. Assertion (A): An intrinsic semi-conductor has low electrical conductivity. Hence, it is normally not used in the device fabrication without doping.

Reason (R): Its electrical resistivity can be increased by raising its temperature.

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65. Assertion (A): An electric or mechanical input makes the flux jump from one superconductor to another, generating large direct currents.

Reason (R): The electric resistivity of superconductors depends upon the magnetic field.

66. Assertion (A): Cryotron is a switch constructed out of superconducting materials.

Reason (R): Switching action is characteristic of superconductors only.

67. Assertion (A): Soft magnetic material is used in making electromagnets.

Reason (R): Soft magnetic materials have a high coercive field.

**IES-2005**

68. What are the materials which exhibit electric polarization even in the absence of an applied electric field called?

- a. Ferromagnetic
- b. Paramagnetic
- c. Ferroelectric
- d. Anti-ferroelectric

69. The magnetic field at which a super-conductor remains in its superconducting state at a temperature less than the transition temperature is

- a. zero
- b. Greater than the critical field corresponding to the given temperature
- c. Less than the critical field corresponding to the given temperature
- d. Equal to the critical field corresponding to the transition temperature

70. Consider the following statements regarding magnetic materials:

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1. Relative permeability of \_\_\_\_\_ is 0.99999 and that of oxygen is 1.00002; hence water is dia-magnetic and oxygen is para magnetic material.
2. Ferrimagnetic material has no eddy current loss.
3. Permalloy and Alnico are two examples of hard magnetic materials,
4. The magnetization and applied electric field in ferro-magnetic materials are related non linearly.

Which of the statements given above are correct?

- a. 1, 2 and 3                      b. 2, 3 and 4
  - c. 1, 3 and 4                      d. 1, 2 and 4
- 
71. The hysteresis loop for the material of the core of a transformer should be
    - a. Short and narrow                      b. Tall and narrow
    - c. Short and wide                      d. Tall and wide
  72. All magnetic materials lose their magnetic properties when
    - a. Cooled to low temperature
    - b. Heated to high temperature
    - c. Kept in an aluminium box
    - d. Kept in vacuum
  73. The electrical conductivity of a semiconductor increases with increases in temperature because
    - a. The mobility of the carriers increases
    - b. The carrier concentration increases
    - c. Both carrier concentration and mobility increase
    - d. Thermal energy of electrons increases
  74. Which one of the following is not a permanent magnetic material?
    - a. Chromium steel                      b. Silicon iron

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- c. Cobalt steel    d. Alnico

75. In metals, resistivity is composed of two parts; one part is characteristic of the particular substance. The other part is due to

- a. Applied voltage
- b. Crystal imperfections
- c. Applied magnetic field
- d. Supplied thermal energy

76. Fermi level in a p-type semiconductor lies close to

- a. The top of the valance band
- b. The bottom of the valance band
- c. The top of the conduction band
- d. The bottom of the conduction band

77. Above the Curie temperature, ferro-magnetic – materials behaves like

- a. Paramagnetic    b. Diamagnetic
- c. Anti-ferromagnetic    d. Ferrimagnetic

78. Match List-I (Insulating Material) with List-II (Application) and select the correct answer using the codes given below:

List-I

List-II

- |                              |  |
|------------------------------|--|
| a. Stealite                  | 1. Ceramic capacitor                         |
| b. Rutile (Titanium dioxide) | 2. Piezoelectric application                 |
| c. Barium titanate           | 3. Insulating materials for machine windings |
| d. Teflon                    | 4. High frequency insulator                  |

Codes:

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	A	B	C	D
a.	4	3	2	1
b.	2	1	4	3
c.	4	1	2	3
d.	2	3	4	1

79. Match List-I (Magnetic Material) with List-II (Order of Susceptibility) and select the correct answer using the codes given below:

List-I	List-II
a. Diamagnetic	1. $\approx 10^{+5}$
b. Paramagnetic	2. $\approx 10^{-5}$
c. Ferromagnetic	3. $\approx -10^{-5}$

Codes:

	A	B	C
a.	1	3	2
b.	1	2	3
c.	3	2	1
d.	3	1	2

80. Match List-I (Insulator) with List-II (Application) and select the correct answer using the codes given below:

List-I	List-II
a. Mica	1. Bushings
b. Polysterene	2. Electric Wires & cables
c. Poorcelain	3. Low voltage capacitors
d. Silicon rubber	4. Iron
	5. Radio cabinets

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Codes:

	A	B	C	D
a.	4	5	1	2
b.	2	1	3	4
c.	4	1	3	2
d.	2	5	1	4

81. Metallic copper is a

- a. Paramagnetic substance
- b. Diamagnetic substance
- c. Ferromagnetic substance
- d. Ferrimagnetic substance

82. The magnetic field required to reduce the residual magnetization to zero is called

- a. Retentivity
- b. Coercivity
- c. Hysteresis
- d. Saturation magnetization

83. Bohr magneton is unit of

- a. Magnetic energy
- b. Permanent dipole moment due to spin
- c. Polarisability
- d. Hysteresis loss

84. Magnetostriction is a phenomenon of

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- a. Generation of electricity in ferro-magnetic materials
- b. Generation of magnetism in conductors
- c. Change in permeability of ferro-magnetic materials during magnetization
- d. Change in physical dimensions of ferromagnetic materials during magnetization

85. Superconductivity is destroyed

- a. At high temperature
- b. At high magnetic field
- c. In presence of magnetic impurities
- d. In all the above cases

86. Hall Effect can be used

- a. To find type of semiconductor (whether or or n type)
- b. To find carrier concentration
- c. To measure conductivity
- d. All of the above

Direction: The following item consist of two statements one labeled as 'Assertion A' and the other labeled as 'Reason R'. You are to examine these two statements carefully and decide if the Assertion A and the Reason R are individually true and if so, whether the Reason is a correct explanation of the Assertion. Select your answers to these items using the codes given below and mark your answer sheet accordingly.

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- c. A is true but R is false
- d. A is false but R is true

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87. Assertion (A): An insulator has a high value of resistivity and with increasing temperature the value of its resistivity decreases exponentially  
Reason (R): With increasing temperature the value of the energy band gap decreases.

**IES-2006**

88. When the temperature of a magnetic material is raised above the Curie point, it becomes

- a. diamagnetic
- b. paramagnetic
- c. ferromagnetic
- d. ferromagnetic

89. Soft iron is used in the manufacture of electromagnets because of its

- a. high saturation magnetization only
- b. low retentivity only
- c. low coercive field only
- d. high saturation magnetization, low retentivity and low coercive field.

90. With increase in temperature, magnetic susceptibility of a ferromagnetic material will

- a. increase
- b. decrease
- c. increase initially and then decrease
- d. remain constant

91. Match List-I with List-II and select the correct answer using the code given below the lists;

List-I

List-II

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- |                          |                           |
|--------------------------|---------------------------|
| a. No eddy current loss  | 1. Ferrimagnetic material |
| b. Small hysteresis loss | 2. Soft magnetic material |
| c. Large hysteresis loss | 3. Hard magnetic material |
|                          | 4. Non-ferrous material   |

Codes:

	A	B	C
a.	2	1	3
b.	2	3	4
c.	1	3	4
d.	1	2	3

92. What is the packing fraction of a BCC (body-centered cubic) unit cell?

- |                             |                            |
|-----------------------------|----------------------------|
| a. $\frac{\sqrt{3}\pi}{16}$ | b. $\frac{\sqrt{3}\pi}{8}$ |
| c. $\frac{\sqrt{3}\pi}{12}$ | d. $\frac{\sqrt{2}\pi}{8}$ |

93. The relative dielectric constant of solid dielectrics in the alternating field is

- a. maximum at the power frequencies and decreases to unity at frequencies in the ultraviolet range
- b. maximum at the power frequencies and decreases to zero at frequencies in the ultraviolet range
- c. unity at the power frequencies and increases to its maximum value at frequencies in the ultraviolet range
- d. independent of frequency variations

94. Width of energy bands depends on which of the following?

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- a. Temperature
- b. Pressure
- c. Relative freedom of electrons in the crystal
- d. Mass of atom in the material

95. Which one of the following statements is not true for a p-type semiconductor?

- a. conduction is by the movement of holes in the valence band
- b. Holes constitute the majority charge carriers
- c. Fermi level lies closer to the conduction band between the conduction and valence bands
- d. it is formed by adding an acceptor impurity to germanium

96. Principle of Hall effect is used in the construction of which one of the following?

- a. Ammeter
- b. Voltmeter
- c. Galvanometer
- d. Gaussmeter

97. For which one of the following materials, is the Hall coefficient zero?

- a. Metal
- b. Insulator
- c. Intrinsic semiconductor
- d. Alloy

98. What is the magnetic susceptibility  $\chi$  of an ideal superconductor?

- a. 1
- b. -1
- c. 0
- d. Infinite

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Direction: The following 2 items consist of two statements one labeled as 'Assertion A' and the other labeled as 'Reason R'. You are to examine these two statements carefully and decide if the Assertion A and the Reason R are individually true and if so, whether the Reason is a correct explanation of the Assertion. Select your answers to these items using the codes given below and mark your answer sheet accordingly.

- a. Both A and R are true and R is the correct explanation of A
- b. Both A and R are true but R is not the correct explanation of A
- c. A is true but R is false
- d. A is false but R is true

99. Assertion (A): A p-type GaAs sample can be converted to a semi-insulating substrate by doping it with chromium

Reason (R): Chromium increases the band gap of GaAs.

100. Assertion (A): Superconductivity of a superconducting material can be destroyed by application of an external magnetic field.

Reason (R): If the applied magnetic field is greater than the critical magnetic field at a given temperature which is more than the transition temperature, superconductivity can be destroyed.

101. With increase in applied frequency, the dielectric loss in a material will

- a. increase
- b. decrease
- c. remain constant
- d. become zero

102. Match List-I (Material) with List-II (Curie Temperature) and select the correct answer using the code given below the lists:

List-I

List-II

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- a. Fe 1. 783 K
- b. MnOFe<sub>2</sub>O<sub>3</sub> 2. 523 K
- c. MgOFe<sub>2</sub>O<sub>3</sub> 3. 863 K
- d. NiOFe<sub>2</sub>O<sub>3</sub> 4. 1043 K

Codes:

	A	B	C	D
a.	2	3	4	1
b.	4	1	2	3
c.	2	1	4	3
d.	4	3	2	1

103. 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. All temperatures

104. Elements can reach a stable atomic structure by

- a. losing electrons only
- b. gaining electrons only
- c. losing or gaining or sharing electrons
- d. collisions between atoms

105. The values of radiative and non-radiative theme of minority carriers in a semiconductor are 50 ns and 100 ns, respectively. What is the effective lifetime?

- a. 12.2 ns
- b. 150 ns
- c. 33.3 ns
- d. 75 ns

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106. Match List-I (Parameter) with List-II (Unit) and select the correct answer using the codes given below the lists:

List-I

List-II

- |                               |  |
|-------------------------------|--|
| a. Boltzmann constant         | 1. farad/meter                               |
| b. Permeability of free space | 2. $\text{cm}^2/\text{volt} - \text{second}$ |
| c. Permittivity of free space | 3. henry/meter                               |
| d. Mobility                   | 4. $\text{cm}^2/\text{second}$               |
|                               | 5. electron volt/Kelvin                      |

Codes:

	A	B	C	D
a.	5	2	1	4
b.	1	2	5	4
c.	5	3	1	2
d.	1	3	5	2

107. III-V alloy semiconductor crystallizes in what form?

- a. Simple cubic structure
- b. Body-centered cubic structure
- c. Zinc blends structure
- d. Wurtzite structure

**IES-2007**

108. Assertion (A): At absolute zero degree Kelvin temperature the semiconductor materials behave as insulators.

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Reason (R): At absolute zero degree Kelvin temperature; there is no energy available to generate the current carriers in the semiconductor

- a. Both A and R are true and R is the correct explanation of A
- b. Both A and R are true but R is not the correct explanation of A
- c. A is true but R is false
- d. A is false but R is true

109. Which one of the following is the Fermi function  $f(E)$ ?

a.  $\frac{1}{1 + e^{(E-E_F)/(kT)}}$

b.  $\frac{1}{1 - e^{(E-E_F)/(kT)}}$

c.  $\frac{1}{1 + e^{(E_F-E)/(kT)}}$

d.  $\frac{1}{1 - e^{(E_F-E)/(kT)}}$

110.  $h$  = half centre to centre spacing,  $r$  = conductor radius and  $\epsilon$  = permittivity of the medium. Which one of the following is equal to the capacitance per unit length of a two-wire transmission line?

a.  $\frac{\pi \epsilon}{\log_e \left\{ \left( \frac{h}{r} \right) + \left( \sqrt{\frac{h^2}{r^2} - 1} \right) \right\}}$

b.  $\frac{2\pi \epsilon}{\log_e \left\{ \left( \frac{h}{r} \right) + \left( \sqrt{\frac{h^2}{r^2} - 1} \right) \right\}}$

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c. 
$$\frac{3\pi \epsilon}{\log_e \left\{ \left( \frac{h}{r} \right) + \left( \sqrt{\frac{h^2}{r^2} - 1} \right) \right\}}$$

d. 
$$\frac{4\pi \epsilon}{\log_e \left\{ \left( \frac{h}{r} \right) + \left( \sqrt{\frac{h^2}{r^2} - 1} \right) \right\}}$$

111. In which one of the following magnetic materials, is the net magnetic moment zero?

- a. Paramagnetic                      b. Ferromagnetic  
c. Ferrimagnetic                      d. Anti-ferrimagnetic

112. What is the output voltage produced across the crystal by Hall effect, due to?

- a. Drop across the crystal due to current passing through it  
b. Movement of charge carriers towards one end  
c. Induced voltage by the applied magnetic field  
d. Induced voltage by the applied electric field

113. The measurement of which one of the following will reveal the sign of the charge carriers?

- a. Conductivity                      b. Mobility  
c. Hall coefficient                      d. Diffusion constant

114. Which one of the following is the correct statement?

YIG and YAG are two types of crystals used extensively in technology and are

- a. non-magnetic and magnetic, respectively

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- b. magnetic and non-magnetic, respectively
- c. both magnetic
- d. both non-magnetic

115. Consider the following:

Applications of low permittivity ceramics include which of the following/

1. Suspension insulators for high voltage lines
2. Superconductors.
3. Pin insulators for low voltage lines.

Select the correct answer using the code given below;

- a. 1 and 2
- b. 1 and 3
- c. 2 and 3
- d. 1, 2 and 3

116. What is a material with equal, anti-parallel atomic magnetic moments, known as?

- a. Ferrimagnetic
- b. Ferrite
- c. Ferromagnetic
- d. Anti-Ferromagnetic

117. A coil wound on a magnetic core is excited from an a.c. source. The source voltage and its frequency are both doubled. What will be the eddy current loss in the core?

- a. Four times the original value
- b. Double the original value
- c. Same as the original value
- d. Half the original value

118. Match List-I (material) with List-II (Properties) and select the correct answer using the code given below the lists:

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List-I

- a. Superconductor at very low temperatures
- b. Ferric chloride
- c. Diamond
- d. Manganese oxide

List-II

- 1. Susceptibility +ve
- 2. Very small – ve susceptibility
- 3. Very high- ve susceptibility
- 4. Susceptibility inversely proportional to  $1+\theta$

(Here T is temperature of the material in Kelvin,  $\theta$  is a constant for a material)

Codes:

	A	B	C	D
a.	2	4	3	1
b.	3	1	2	4
c.	2	1	3	4
d.	3	4	2	1

119. Which of the following exhibit electric hysteresis?

- a. Ferromagnetic materials only
- b. Ferroelectric materials only
- c. Ferrielectric materials only
- d. Both ferroelectric and ferromagnetic materials

120. Consider the following statements in connection with superconductors:

- 1. Transition temperature of a superconductor can be reduced by the application of a magnetic field.
- 2. Transition from the superconducting to normal state under the influence of a magnetic field is irreversible

Which of the statements given above is/are correct?

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- a. 1 only                      b. 2 only  
c. Both 1 and 2              d. Neither 1 nor 2

121. Which one of the following is the correct statement?

Superconducting metal in super-conducting state has relative permeability of

- a. more than one              b. one  
c. zero                          d. negative

122. The temperature coefficient of resistance of a wire is  $0.0008/^{\circ}\text{C}$ . If the resistance of the wire is 8 Ohm at  $0^{\circ}\text{C}$ , what is the resistance at  $100^{\circ}\text{C}$ .

- a. 8.64 Ohm                    b. 8.08 Ohm  
c. 7.92 Ohm                    d. 7.20 Ohm

123. Tunnel diode is commonly used as which one of the following/

- a. Logic memory storage device  
b. FM modulator  
c. Voltage regulator  
d. AM Modulator

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124. Assertion (A): Ferrites are useful at very high frequencies.

Reason (R): Ferrites have high permeability and high resistivity.

- a. Both A and R are true and R is the correct explanation of A  
b. Both A and R are true but R is not the correct explanation of A  
c. A is true but R is false  
d. A is false but R is true

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125. Two materials having temperature coefficient of 0.004 and 0.0004 respectively are joined in series. The overall temperature coefficient is approximately

- a. 0.08                      b. 0.04  
c. 0.001                     d. 0.0001

126. Which one of the following is the correct statement?

During the process of magnetization of ferromagnetic material, the magnetic domain

- a. only expand  
b. rotate first and then expand  
c. expand first and then rotate  
d. neither rotate nor expand

127. Consider the following statements about p-n junctions:

- 1.p-n junction behaves as a capacitor when forward biased.
2. p-n junction has p and n type semiconductors with depletion layer in between.
3. p-n junction has a wider depletion layer as compared to a Zener diode.

Which of the statements given above are correct?

- a. 1, 2 and 3                      b. 1 and 2  
c. 2 and 3                         d. 1 and 3

128. Which one of the following is the correct statement?

When a p-n junction is reverse – biased, then

- a. holes and electrons move away from the junction  
b. depletion region decreases  
c. barrier breaks down

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d. minority carriers are not affected

129. Consider the following statements about semiconductors?

1. The forbidden energy gap in semiconductors lies between the valence band and conduction band.

2. The forbidden energy gap in germanium at 0 K is about 0.72 eV.

3. Semiconductors have negative temperature coefficient of resistivity.

Which of the statements given above are correct?

- a. 1, 2 and 3                      b. 1 and 2  
c. 2 and 3                         d. 1 and 3

130. Fermi level in a p-type semiconductor lies close to which one of the following?

- a. The top of the valence band  
b. The bottom of the valence band  
c. The top of the conduction band  
d. The bottom of the conduction band

131. Match List-I (Material) with List-II (Application) and select the correct answer using the code given below the lists:

List-I

List-II

- |                  |                                |
|------------------|--------------------------------|
| a. Silicon steel | 1. High frequency transformers |
| b. Ferrites      | 2. Permanent magnets           |
| c. Alnico        | 3. Current transformers        |
|                  | 4. Power transformers          |

Codes:

- |      |   |   |
|------|---|---|
| A    | B | C |
| a. 1 | 2 | 4 |

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- b. 4      3      2
- c. 3      4      1
- d. 4      1      2

132. Materials which lack permanent magnetic dipoles are known as

- a. Paramagnetic                      b. Diamagnetic
- c. Ferromagnetic                      d. Ferrimagnetic

133. Why is the core of the transformer built up of laminations?

- a. To reduce eddy current loss
- b. For convenience of fabrication
- c. No specific advantage
- d. For increasing the permeability

134. Which of the following is/are primary standard(s) for voltage maintained by National standards Laboratories?

- 1. Zener diode with 1.5 V output at 20<sup>0</sup>C
- 2. Nickel cadmium rechargeable cell of 1.25 V output at 20<sup>0</sup>C.

Select the correct answer using the code given below:

- a. 1 only                                      b. 2 only
- c. Both 1 and 2                              d. Neither 1 nor 2

135. The electronic polarisability of an inert gas atom is proportional to which one of the following

- a. R    b. R<sup>2</sup>
- c. R<sup>3</sup>    d. R<sup>4</sup>

(Where R is the radius of the atom)

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136. In the case of a dielectric subjected to an alternating electric field of frequency  $f$ , the dielectric loss is proportional to which one of the following?

- a.  $f$                       b.  $f^2$   
c.  $1/f$                       d.  $1/f^2$

137. Which one of the following is the correct statement?

The orientational polarizability in a polyatomic gas is proportional to

- a. temperature  $T$                       b.  $1/T$   
c.  $T^2$                                       d. independent of  $T$

**ANSWERS & SOLUTIONS**

1. (a)  
2. (d)  
3. (b)

$$W_E = \frac{1}{2} CV^2 = \frac{1}{2} \int \epsilon_0 \epsilon_r E^d \nu \Rightarrow W_E \propto \epsilon_r$$

4. (a)

$$W \text{ (dielectric loss)} = \frac{\omega}{2} \cdot \epsilon_0 \cdot \epsilon_r'' E - 0^2 i e. (\propto \omega)$$

5. (c)

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Electronic and ionic polarizability remain constant with increase in temperature but orientational polarization is inversely proportional to the temperature.

6. (c)

$$\text{Uniaxial stress (p)} = Y \cdot \frac{\Delta C}{C}$$

$$q = CV = \text{Polarisation} \quad P = \frac{q}{A} = \frac{C}{A} \cdot V$$

where A is area of the crystal capacitor.

$$\therefore \Delta P = \left(\frac{V}{A}\right) \cdot \Delta C$$

$$\Rightarrow \frac{\Delta P}{P} = \frac{\Delta C}{C}$$

= stress (p)

$$= Y \cdot \frac{\Delta P}{P} = 130X \frac{10}{500} = 2.6GPa$$

7. (d)

$$8. \quad \lambda \propto \frac{1}{\text{Energy of the electron}}; \text{ slow moving electron has low energy}$$

9. (a)

The transition temperature of a superconductor can be reduced by the application of a magnetic field. Suppose a superconductor has a temperature  $T < T_c$ . If a magnetic field H is applied, the material remains superconducting until a critical field  $H_c$  is reached such that for  $H > H_c$ , the material is in the normal state.

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- 10. (a)
- 11. (b)
- 12. (c)
- 13. (d)
- 14. (c)

15. (d)

Electrons are accelerated not holes which are not a physical charge carriers.

- 16. (a)
- 17. (a)
- 18. (b)
- 19. (a)
- 20. (b)

Fermi-Dirac probability function  $F(E)$  is given by

$$f(E) = \frac{1}{1 + e^{(E-E_f)/kT}}$$

Where  $E_f$  = Fermi level

If  $E = E_f$  then  $f(E) = 1/2$  for any value of temperature. Thus, the Fermi level represents the energy state with 50% probability of being filled if no forbidden band exists.

- 21. (c)
- 22. (a)
- 23. (c)

In the case of solids and liquids, internal field  $\bar{E}_i$  is not equal to the applied

field  $\bar{E}$ , (for gases  $\bar{E}_i = \bar{E}$ ); and  $\bar{E}_i = \bar{E} + \left(\frac{\lambda}{E_0}\right) \bar{P}$

For cubic symmetry,  $\gamma = \frac{1}{3}$

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$$\therefore \bar{E}_i = \bar{E} + \frac{\bar{P}}{3 \epsilon_0}$$

24. (b)

Loss factor  $\tan \delta = \frac{\epsilon''}{\epsilon'}$

25. (d)

The dielectric losses in the radio frequency region are usually due to dipole rotation (i.e. oriental polarization) or to ions (i.e. ionic polarization) jumping from one equilibrium position to another. But, the losses in the optical region are associated with the electrons (i.e. electronic polarisaibility).

26. (c)

27. (c)

The transition temperature of a super conductor can be reduced by the application of a magnetic field.

28. (c)

$$T_c = 4.12^0 \text{ K with } H_c = 0.$$

29. (d)

$$\lambda = \frac{h}{p} \text{ where } p = mv$$

30. (b)

The dc resistivity of ferrites is many orders of ten higher than that of iron; consequently it prevents penetration of magnetic flux into the material. Further,

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coercive force ( $H_c$ ) for a high stability permanent magnet may be as high as stability permanent magnet may be as high as  $10^6$  ampere –  $m^{-1}$  as compared to ferrites having as low as 1 ampere –  $m^{-1}$ .

31. (a)

Electrical resistivity has to be high for ferrites, not for 4% Si-Fe which is ferromagnetic material. Further upon adding 4% Si, coercive force and  $B_{sat}$  both decreases.

32. (a)

33. (d)

An undoped semiconductor will behave as a perfect insulator at  $0^0$  K.

34. (c)

35. (a)

36. (a)

37. (b)

For Si,  $E_G = 1.21 - 3.60 \times 10^{-4}T$

At  $300^0$  K,  $E_G = 1.21 - 0.108 = 1.1$  e V

38. (d)

Fermi level in an intrinsic semiconductor is independent of temperature

39. (d)

40. (a)

41. (b)

42. (b)

$$E_i = \frac{E_{applied}}{1 - \frac{1.2\alpha_e}{\pi\epsilon_0 a^3}}$$

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Where  $a$  is interatomic distance

43. (b)

$$\frac{K}{\sigma} = \frac{\pi^2 K^2}{3e^2}, \text{ where}$$

$K \rightarrow$  thermal conductivity

$\Sigma \rightarrow$  electrical conductivity

44. (b)

45. (a)

46. (c)

As long as the electronic structure of the material is independent of temperature, the diamagnetic susceptibility is also essentially independent of temperature.

47. (d)

48. (a)

49. (a)

$$I_0 = 2 \times 10^{-7} \text{ A} \quad \therefore I \simeq I_0 e^{\frac{v}{\eta V_T}}$$
$$\eta = 1 \text{ for Si, } V_T = \frac{kT}{q} = \frac{1.38 \times 10^{-23} \times 300}{1.6 \times 10^{-19}}$$

$$\therefore I = 2 \times 10^{-7} \exp \frac{1.6 \times 10^{-19} \times 0.01}{1.38 \times 10^{-23} \times 300}$$

50. (a)

$$\sigma = ne (\mu_e + \mu_h)$$

51. (a)

52. (d)

53. (d)

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54. (d)

Superconductivity in a long circular wire of radius  $r$  may be destroyed when the current exceeds the value  $I_c$ , which at the surface of the wire would produce the critical magnetic field  $H_c$ . Hence, the critical current  $I_c = 2\pi r H_c$  this is referred to as Silsbee's rule. This rule prevents the use of superconductors as coils for the production of strong magnetic fields

55. (d)

56. (b)

$$\tan \delta = \frac{\epsilon_r''}{\epsilon_r'} \text{ and } \epsilon_r^* = \epsilon_r' - j \epsilon_r''$$

$$\epsilon_r'' = 4 \times 0.004 = 0.016 \Rightarrow \epsilon_r^* = 4 - j0.016$$

57. (d)

58. (c)

Quartz crystal is a piezoelectric material.

59. (b)

The Neel temperature plays a similar role antiferromagnetic materials as does the ferromagnetic curie temperature in ferromagnetic materials.

60. (b)

61. (b)

The dc resistivity of ferrites is many orders of ten higher than that of iron, consequently the eddy current problem preventing penetration magnetic flux into the material is much less severe in ferrites than in iron.

62. (d)

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$$V_H = -\frac{B_z \cdot I_x}{e \cdot n_e \cdot d}$$

where d is thickness of the crystal.

63.(d)

$$R_H = \frac{1}{e \cdot n_h} = -\frac{1}{e \cdot n_e}$$

= Large Hall coefficients correspond to low carrier densities (e.g. intrinsic semiconductor) and hence to purer samples.

64. (c)

By raising temperature electrical conductivity would increase and resistivity would decrease.

65. (d)

If a magnetic field H is applied, the material remains superconducting until a critical field  $H_c$  is reached such that for  $H > H_c$ , the material is in the normal state.

66. (c)

67. (c)

Hard magnetic materials have a high coercive field.

68. (c)

Ferroelectric materials exhibits by offering similar to those observed in ferromagnetic materials.

69. (c)

If a magnetic field H is applied, the material remains superconducting until a critical field  $H_c$  is reached such that for  $H > H_c$ , the material is in the normal state.

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70. (a)

71. (b)

It should have high  $B_{\text{saturation}}$  and low coercive field  $H_c$ .

72. (b)

$$\chi(\text{susceptibility}) \propto \frac{1}{\text{Temperature}}$$

73. (b)

With increase in temperature more covalent bonds are ruptured so more free electrons are available for conduction. Mobility of the carriers decreases with increase in temp.

74. (b)

4% Si- Fe is a soft magnetic material having coercive field  $H_c = 40 \text{ amp-m}^{-1}$

75. (b)

76. (a)

77. (a)

78. (c)

79. (c)

80. (d)

81. (b)

82. (b)

83. (b)

84.(d)

85. (d)

Refer explanation of question no. 69.

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86. (d)

87. (d)

Insulator resistance decreases but not exponentially with increasing temperature.

88. (b)

In the region above the ferromagnetic curie temperature, the behaviour of a ferromagnetic material is some what similar to that of a paramagnetic material. Below the ferromagnetic curie temperature, ferromagnetic materials exhibit the well-known hysteresis in the B versus H curves.

89. (c)

Magnetic materials which have low coercive field are known as soft materials. Permanent magnets are made of hard materials which have a broad hysteresis loop (large coercive force), so that they are not subject to self demagnetization.

90. (b)

$$\lambda = \frac{C}{(T - \theta)}$$

91. (d)

Refer, explanation for the question no. 90, Also, ferrimagnetic material such as ferrites do not have eddy current loss.

92. (a)

93. (a)

At high frequencies dielectric constant is a complex quantity. Imaginary parties responsible for dielectric loss.

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**Material Science OLD IES in EEE stream questions**

94. (a)

For example, energy gap ( $E_G$ ) variation of silicon with tem (T) is  $E_G(T) = 1.21 - 3.6 \times 10^{-4}T$

95. (c)

Fermi level lies closer to the valence band between the conduction and valence bands.

96. (a)

The device serves to measure current in a conductor without the need for interrupting the circuit without the need for interrupting the circuit and without making electrical connection between the conductor circuit and the meter. Half voltage produced is proportional to the magnetic field strength set up by the current. This magnetic field is proportional to the current.

97. (a)

Large Hall coefficient correspond to low carrier densities and hence to purer samples.

i.e.  $R_H \propto \frac{1}{n}$

98. (b)

$\chi = \mu_r = 1$ , for superconductor  $\mu_r = 0$  which is referred as perfect diamagnetism.

99. (\*)

100. (c)

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Temperature should be less than the transition temperature.

101. (a)

Refer, explanation of question no. 93

102. (d)

103. (a)

At absolute zero, silicon and germanium are insulators, simply because there are no mobile charge carriers available.

104. (c)

105. (d)

$$\text{Average} = \frac{150}{2} = 75 \text{ ns}$$

106. (c)

107. (\*)

108. (a)

By Fermi-Dirac function  $f(E) = \frac{1}{1 + (e)^{\frac{E-E_f}{KT}}} = 0$

For  $T = 0^0 \text{ k}$ .

109. (a)

110. (\*)

111(d)

112. (b)

113. (c)

114. (b)

In YIG, 1 represent Iron (Yattri Iron Garnet)

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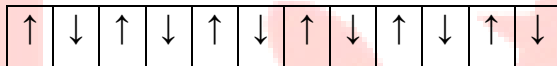
In YAG, A represent Aluminium (Yattri Aluminium garnet)

115. (b)

Low permittivity ceramics cannot be super conductor.

116. (d)

Dipole moment for antiferromagnetic



117. (a)

$$P_e = K_e B^2 f^2; B = \frac{V}{f} = \text{const. if both doubled}$$

$$\text{So, } P_e = K_e f^2$$

118. (c)

Super conductor is diamagnetic so very small (-Ve) susceptibility. Ferric chloride is paramagnetic so susceptibility + Ve. MnO is Antiferro so follow curie weiss law after Neel temperature.

119. (d)

As like ferromagnetic & ferrimagnetic.

120. (c)

If applied magnetic field is more than critical field transition temperature will be reduced.

Super contractor are used as a Magnetic Switch which can be on & off by application of temperature or Magnetic field.

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121. (c)

Field exclusion law (Meissner effect)

122. (a)

$$R = R_0 (1 + \alpha \Delta t)$$

123. (b)

124. (a)

High permeability and resistivity are main cause of application at high frequency for ferrites.

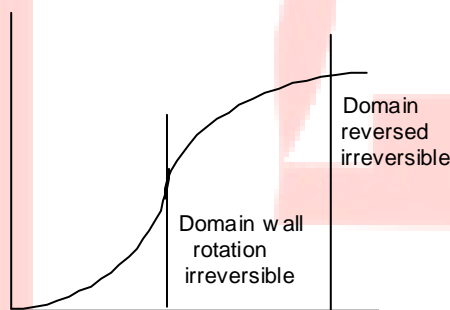
125. (c)

Here temperature coefficient means resistance temperature coefficient so on connection series overall coefficient will be average of two.

Nearest average value of two given coefficient is 0.001.

126. (c)

On application of field firstly Domain wall rotates but reversible



Domain wall rotation reversible  
Magnetisation Curve

127. (a)

PN junction also behave as a capacitor when reverse biased but value of capacitor is less. Zener diode is heavily doped so thin depletion layer.

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128. (a)

By this way width of depletion layer increased.

129. (d)

Energy gap in Germanium is 0.785 eV at 0° K but at room temperature it is 0.72 so point No. 2 is wrong.

130. (a)

In N type it is below conduction band.

131. (d)

132. (d)

133. (a)

$$P_e = k_e B^2 f^2 t^2$$

134. (a)

Zener diode is used as secondary standard.

135. (b)

$$\alpha_e = 4 \pi \epsilon_0 R^3$$

136. (a)

Dielectric loss  $\propto V^2 fC$ .

137. (b)

$$\alpha_0 = \frac{\rho_p^2}{3KT}$$

Where,  $\rho_p$  = Permanent dipole moment.

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