Mark Scored:

KATHMANDU UNIVERSITY
End Semester Examination
February/March, 2019

Level : B. E.
Year : II
Course : EEEG 207
Semester : I

Exam Roll No. :
Time: 30 mins.
F. M. : 20

Registration No. :
Date FEB 25 2019

SECTION "A"
[20 Q × 1 = 20 marks]

Choose the most appropriate option.

1. If T represents the transmissivity, which of the following is correct expression for the absorptivity of light by a material?
   a. A = 10 log(1/T) b. log(1/T) c. 10 log(T) d. 20 log(1/T)

2. Which if the following is the polar dielectric material?
   a. CH_4 b. CO_2 c. HCl d. N_2

3. The total number of atoms in body centered cubic unit cell is given by _____
   a. 1 b. 2 c. 8 d. 9

4. What would be the mobility of electron in copper if there are $9x10^{28}$ valance electron per meter cube and the conductivity of copper is 6×10^{7} $(\Omega m)^{-1}$.
   a. 4.16×10^{-3} $m^2/v.s$ b. 1.6×10^{-2} $m^2/v.s$ c. 5.7×10^{-4} $m^2/v.s$ d. 7.6×10^{-1} $m^2/v.s$

5. If a photon of energy $1.53X10^{-19}$ J is incident in a photodiode resulting in a photocurrent of 6.5μA and given that the optical power falling on the diodes is 10μW. The responsivity and quantum efficiency are given by
   a. 0.65 A/W, 62% b. 0.35 A/W, 50% c. 0.65 A/W, 70% d. 0.45 A/W, 50%

6. The ionic polarization occurs at frequencies range _____
   a. 10^{10}-10^{12} Hz b. 10^{6}-10^{9} Hz c. 10^{13}-10^{15} Hz d. 10^{16}-10^{18} Hz

7. Which of the following is not the ferroelectric material?
   a. Quartz b. BaTiO3 c. Rochelle salt d. $PbTiO_3$

8. A uniform silver wire has a resistivity of 1.54×10^{-18} ohm/m at room temperature. For an electric field along the wire of 1 volt/cm, the mobility, assuming that there are 5.8×10^{28} conduction electrons/m^3 is _____
   a. 1.54 m^2/Vs b. 6.9973m^2/Vs c. 6.9973×10^{-3} m^2/Vs d. 0.69973 m^2/Vs

9. If ε is the permittivity of a medium and ε_0 is the permittivity of free space, which of the following represents the dielectric constant?
   a. $\varepsilon\ \varepsilon_0$ b. $\varepsilon/\ \varepsilon_0$ c. $\varepsilon_0/\varepsilon$ d. $2\varepsilon/\ \varepsilon_0$

10. Which of the following material is used in microphone?
    a. Paramagnetic b. Ferromagnetic c. Diamagnetic d. Piezoelectric

11. The target breeding ratio in liquid metal fast breeder reactor is _____
a. 1:1 b. 1:2 c. 1:3 d. 1:4

12. Which of the following is the most commonly used material for metallization in IC fabrication process?
a. Copper b. Silver c. Aluminum d. Mercury

13. In which types of diode the P and N regions are heavily doped?
a. Varactor diode b. PIN diode c. Zener diode d. Tunnel diode

14. If χ represents the susceptibility, C represents the Curie constant, θ represents the Curie temperature and T is absolute temperature which of the following is true for antiferromagnetic materials?
a. $\chi = C/(T - \theta)$ b. $\chi = C/(T + \theta)$ c. $\chi = (T - \theta)/ C$ d. $\chi = (T + \theta)/ C$

15. At what temperature can we expect a 10% probability that electrons in silver have an energy which is 1% above the Fermi energy? ($E_F = 5.5eV$)
a. 290 K b. 390 K c. 490 k d. 590 K

16. Which of the following expression relates the edge length (A) of the cube and the atomic radius (R) of FCC structure?
a. $A = 2R$ b. $A = 2\sqrt{R}$ c. $A = \sqrt{2}\,R$ d. $A = \sqrt{8}\,R$

17. Which of the following diode is reversed biased?
a. Varactor diode b. Laser diode
c. Light emitting diode(LED) d. Schottky diode

18. In which mode of BJT operation both junctions are reversed biased?
a. Active b. Saturation c. cut off d. reverse active

19. Which of the following does not represent the photolithography process in IC fabrication?
a. Oxidation b. Photoresist c. Masking d. Exposure

20. Which of the following is the example of hard super conductor?
a. Al b. $BaBi_3$ c. Zn d. Sn

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Time : 2 hrs. 30 mins.

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Semester : I
F. M. : 55

SECTION "B"
[5 Q × 11 = 55 marks]

Attempt *ANY FIVE* questions. Figure in the margin indicates the full mark. **Symbols have their usual meaning**. Students are required to answer in their own words as far as practicable.

1.
a) The magnetic moment of an electron in the ground state of the hydrogen atom is 1 Bohr magneton. Calculate the induced magnetic moment in a field of 1 T. [3]
b) What is Hall Effect and how does this occur? Obtain the Hall voltage using relevant diagram. [5]
c) Clarify the importance of Fermi-Dirac distribution function with examples. [3]

2.
a) How does a tunnel diode work? Interpret with the help of energy band diagram of a tunnel diode and draw VI curve. [5]
b) Derive an expression to locate the Fermi energy level in p type semiconductor material. [6]

3.
a) How is the resistivity of metals affected by temperature? Expound with relevant mathematical expression. [3]
b) Write the properties, types and applications of superconductors. [5]
c) Calculate the effective number of electron in body centered cubic unit cell and find the packing fraction. [3]

4.
a) Distinguish between fuel cells and electric batteries with the help of suitable diagrams.[5]
b) Find the expression for the relaxation time in terms of conductivity of a metal. Also define the related terms, collision time and mean free path. [3]
c) Show that the average kinetic energy of free electrons, following Fermi-Dirac statistics is $(3/5)E_F$ at T = 0K. [3]

5.
a) Why is photoresist used during photolithography process in IC fabrication? Also briefly explain epitaxy, etching and metallization with reference to any practical aspect. [6]
b) How does polarization occur in dielectric material? Briefly get across the types of polarization. [5]

6.
a) Obtain expression for the hole concentration as a function of distance using carrier injection method in semiconductor materials. Also write expression for diffusion length.[5]
b) Write short notes on: [2 × 3]
(i) Phototransistor (ii) Magnetic levitation