Marks scored:

KATHMANDU UNIVERSITY
End Semester Examination [C]
July, 2017

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

Exam Roll No. :
Time: 30 mins.
F. M. : 10

Registration No.:
Date : JUL 0 5 2017

SECTION "A"
[20 Q. × 0.5 = 10 marks]

Choose the most appropriate option. Symbols have their usual meaning.

1. Packing efficiency of face centered cubic (FCC) unit cell is given by
a. 54% b. 64% c. 74% d. 84%

2. At 6 K, critical field is $5x10^3$ Am^{-1}. The critical temperature when magnetic field is $2x10^4$ Am^{-1} at 0 K is .....
a. 6.92 K b. 3.90 K c. 1.93 k d. 9.90 K

3. The lowest energy of an electron confined to move in one dimensional potential box of length $1A^0$ is .....
a. 27.01 eV b. 37.51 eV c. 47 eV d. 57.31eV

4. The probability that an electron occupies energy level which is 3 KT below Fermi level is given by
a. 0.65 b. 0.75 c. 0.85 d. 0.95

5. The responsivity of a detector having quantum efficiency of 1% at 0.8μm wavelength is
a. 6.4 mA/W b. 4.4 mA/W c. 2.4 mA/W d. 0.4 mA/W

6. 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 $6 \times 10^7 (\Omega m)^{-1}$.
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} $m^2/v.s$

7. According to Beer's law, the transmittance for a transparent material is equal to
a. 0.5 b. 0.3 c. 0 d. 1

8. In which of the following materials Fermi energy level lies exactly half way between the top of the valance band and bottom of the conduction band?
a. Metals b. Intrinsic semiconductors
c. N type semiconductors d. P type semiconductors

9. A sample of Si is doped with 10^{17} Pb atoms/cm^3. What Hall voltage would you expect in 100 μm thick sample? Given I_x =1 mA, $B_z = 10^{-5}$ wb/cm^2 and mobility = 700 cm^2/vs
a. -62.5 μv b. -52.5 μv c. c. -42.5 μv d. -32.5 μv

10. What should be the energy of an electron so that the associated electron waves have wavelength of 600nm?
a. 2.1×10^{-6} eV b. 4.8×10^{-6} eV c. $6.8x10^{-6}$ eV d. 8.8×10^{-6} eV

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11. If x 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 ferromagnetic materials?
a. $x = C/(T - \theta)$ b. $x = C/(T + \theta)$ c. $x = (T - \theta)/ C$ d. $x = (T + \theta)/ C$

12. Which of the following represents the photolithography process in IC fabrication?
a. Oxidation b. Epitaxial growth
c. Masking and UV application d. Diffusion

13. Schordinger wave equation is a
a. Linear equation b. differential equation
c. Partial differential equation d. both (a) and (b)

14. If temperature is increased, the temperature coefficient of a metal
a. Increases b. Decreases
c. Remains constant d. May increase or decrease

15. When ferromagnetic substance is magnetized, there are small changes in dimensions. This phenomenon is called
a. hysteresis b. magnetostriction c. diamagnetism d. dipolar relaxation

16. In a piezoelectric crystal, the application of mechanical force will cause
a. deformation of crystal b. magnetic dipoles in crystal
c. electrical polarization in crystal d. shift in Fermi level

17. The Ohm's law for conduction in metal is
a. $J = \sigma E$ b. $J = \sigma/E$ c. $J = E/\sigma$ d. $E = J\sigma$

18. In which of the following the width of the junction barrier is very small?
a. Photo diode b. PIN diode c. Schotty diode d. Tunnel diode

19. For a Junction FET, in the pinch off region as the drain voltage is increased, the drain current
a. becomes zero b. abruptly decreases
c. abruptly increases d. remains constant

20. Measurement of Hall coefficient enables the determination of
a. recovery time for stored carrier
b. type of conductivity and concentration of charge carriers
c. temperature coefficient and thermal conductivity
d. Fermi level and forbidden energy gap

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Time : 2 hrs. 30 mins.

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Semester: I
F. M. : 40

SECTION "B"
[4 Q × 10 = 40 marks]

Attempt *ANY FOUR* 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. Define lattice and basis in crystalline structure. Also Find the packing fraction of body centered cubic unit cell (BCC). [1+4]
b. Derive the time independent form of Schordinger wave equation and also write the significance of Schordinger equation. [4+1]

2.
a. Determine the critical temperature and critical field at 4.2 K for a super conductor if the critical fields are 1.41×10^5 Am^{-1} and 4.204×10^5 Am^{-1} at 14.1 K and 12.9 K respectively. [4]
b. Which factor is most important for determining the conductivity of materials? Write some assumptions of free electron theory of metals. [1+3]
c. How energy bands are formed in solids? Explain. [2]

3.
a. What does continuity equation specify? Obtain the continuity equation for electrons. [1+4]
b. Derive an expression to locate the Fermi energy level in n-type semiconductor material. [5]

4.
a. Briefly describe the Beer's law in terms of optical properties of materials. [2]
b. Define the effective mass of electron and derive the expression for effective mass of electron. [4]
c. Write the general steps for IC fabrication in reference to bipolar junction transistor. [2]
d. Find the relaxation time of conduction electron in a metal of resistivity of 1.54×10^{-8} Ωm. If the metal has 5.8×10^{28} conduction electron per cubic meter. [2]

5.
a. Using Langevin theory of diamagnetism, derive expression for magnetization and diamagnetic susceptibility. What does negative susceptibility specify? [5]
b. Write short notes on: [2 × 2.5]
(i) Photoelectric effect
(ii) Zincblende