Marks scored:

KATHMANDU UNIVERSITY
End Semester Examination
March/April, 2017

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

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

Registration No.:
Date MAR 30 2017

SECTION "A"
[20 Q. × 0.5 = 10 marks]

Choose the most appropriate option

1. A tennis ball having a mass of 50 g travels with a velocity of 200 km/hr. What is the equivalent wavelength of this ball?
   a. 8.03 eV  b. 6.0 eV  c. 4.7 eV  d. 2.07 eV

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

3. Packing efficiency of simple cubic unit cell is
   a. 52%  b. 62%  c. 72%  d. 82%

4. Which of the following is made from direct band gap materials
   a. Light emitting diode  b. Normal diode
   c. Resisters  d. Capacitors

5. If a photon of energy $1.53 \times 10^{-19}$ J is incident in a photodiode resulting in a photocurrent of 6.5 μA and given that the optical power falling on the diodes is 10 μW. 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 lowest energy of an electron confined to move in one dimensional potential box of length 1 $A^0$ is
   a. 57.1 eV  b. 37.51 eV  c. 777.1 eV  d. 87.51 eV

7. Meissner effect can be observed in
   a. Diamagnetic materials  b. Ferromagnetic materials
   c. Paramagnetic materials  d. Antiferromagnetic materials

8. If E is the energy level of electron and $E_F$ is the Fermi energy level, T = 0 and $E > E_F$ then
   a. The probability of finding an occupied quantum state of energy higher than $E_F$ is zero
   b. All quantum states with energies greater than $E_F$ are occupied
   c. Some quantum states with energies greater than $E_F$ are occupied
   d. Majority of quantum states with energies greater than $E_F$ are occupied

9. In which of the following materials Fermi energy level lies above the valance band?
   a. Metals
   b. Intrinsic semiconductors
   c. N type semiconductors
   d. P type semiconductors

10. A lead superconductor with critical temperature 7.2 K has magnetic field of $6.5 \times 10^{-3}$ $Am^{-1}$ at absolute zero. What would be the magnitude of magnetic field?
   a. $1.16 \times 10^{3}$ $Am^{-1}$ b. $3.16 \times 10^{3}$ $Am^{-1}$ c. $5.16 \times 10^{3}$ $Am^{-1}$ d. $7.16 \times 10^{3}$ $Am^{-1}$

11. If E represents electric field strength, V represents drift velocity then mobility ($\mu_n$) is defined by
   a. $\mu_n = V/E$ b. $\mu_n = E/V$ c. $\mu_n = V.E$ d. $\mu_n = V^2/E$

12. According to Beer's law, the absorbance for a transparent material is equal to
   a. 0.5 b. 0.3 c. 0 d. Infinite

13. Which of the following can be operated with positive as well as negative gate voltage?
   a. JFET
   b. MOSFET
   c. Both JFET and MOSFET
   d. Neither JFET nor MOSFET

14. If $\chi$ represents the susceptibility, C represents the Curie constant, $\theta$ 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. Impact ionization takes place in
   a. LED b. Laser c. PiN d. APD

16. In photoelectric emission, the maximum kinetic energy of emitted electron is proportional to
   a. $\sqrt{f}$ b. f c. $f^2$ d. $f^3$

17. In a varactor diode the increase in width of depletion layer results in
   a. Decrease in capacitance
   b. Increase in capacitance
   c. No change in capacitance
   d. Either increase or decrease in capacitance

18. Which of the following has peak and valley points in V-I curve?
   a. Tunnel diode b. Zener diode c. PiN diode d. Schotty diode

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

20. Which of the following represents the photolithography process in IC fabrication?
   a. Oxidation b. Epitaxial growth c. Etching d. Diffusion

KATHMANDU UNIVERSITY
End Semester Examination
March/April, 2017

MAR 3 0 2017

Level : B. E.
Year : II
Time : 2 hrs. 30 mins.

Course : EEEG 207
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. A copper wire and aluminium wire have same length and resistance. If same current passes through both the wires, which wire will attain higher temperature rise? Justify your answer with proper expressions and characteristic curves. [2]
   b. How are solid structures classified? Find the packing efficiency of a face centered cubic unit cell (FCC). [1+2]
   c. Derive the time dependent form of Schordinger equation and also write the Max Born expression about the probability of finding microscopic particle in a region. [5]

2.
   a. What do you mean by quantum tunneling? Explain the working of tunnel diode. [1+3]
   b. Calculate the energy relative to the Fermi energy for which the Fermi function equals 5%, $K_B$ is Boltzmann constant and T is the absolute temperature. [2]
   c. Explain the working principle of a photo transistor and describe its characteristics with suitable curves? Also describe how it differs from a BJT. [2]
   d. Define Hall Effect and deduce an expression for Hall voltage ($V_H$). [2]

3.
   a. Obtain the Drude's expression for conductivity. [3]
   b. A silicon bar, 0.1 cm long and 100$\mu m^2$ in cross section area is doped with $10^{17}$ $cm^{-3}$ phosphorous. Find current at 300K with 10 Volt applied. [2]
   c. Derive an expression to locate the Fermi energy level in intrinsic semiconductor material. [5]

4.
   a. Classify the dielectric materials and explain the types of dielectric polarization. [3]
   b. Write the differences among diamagnetic, paramagnetic and ferromagnetic materials and state the Curie – Weiss law. [3]
   c. Given a wave function, $F(x) = \sqrt{\alpha}\ e^{-\alpha x}$. Find the probability of existence of particle between x = $1/\alpha$ and x = $2/\alpha$ [2]
   d. Define the terms Phonons, photons and fermions. [2]

5.
   a. Explain the photolithography process implemented in IC fabrication. [2]
   b. Describe the Carrier injection method in semiconductor materials. [3]
   c. Write short notes on: [2 × 2.5]
      (i) Superconductors
      (ii) Fuel cell and materials used in a fuel cell