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PRESIDENCY UNIVERSITY
BENGALURU

SCHOOL OF ENGINEERING

MAKE UP EXAMINATION – JAN 2023

Course Code: PHY1002   **Date**: 27.01.2023

Course Name: Optoelectronics and Device Physics   **Time**: 1.00pm to 4.00pm

Programme & Sem: IB.Tech   **Max Marks**: 100

                                                           Weightage: 50%

Instructions:

(i) *Read the question properly and answer accordingly.*
(ii) *Question paper consists of 3 parts.*
(iii) Scientific and Non-programmable calculators are permitted.
(iv) *Given : $h = 6.625 \times 10^{-34}$ Js; $e = 1.6 \times 10^{-19}$ C; $K = 1.38 \times 10^{-23}$ Jk^{-1}; $c = 3 \times 10^8$ m/s*

Part A [Memory Recall Questions]
Answer all the Questions. Each question carries 2 marks.   (20Qx2M=40M)

1. Identify the best insulator   (C.O.1) (Knowledge)
   a) Aluminum   b) Diamond   c) Wood   d) Silicon
2. Identify the critical field required to destroy the Type-II superconductor
                                                                   (C.O.1) (Knowledge)
   a) 30 T   b) 0.1 T   c) 1 T   d) 3.0 T
3. In the Hall Effect, the electric field is in the X-direction and the velocity is in the Y-direction. What is the direction of the magnetic field?   (C.O.1) (Knowledge)
   X   b) Y   c) XY plane   d) Z
4. Which dopant will result in p-type semiconductor?   (C.O.1) (Knowledge)
   a) P   b) Si   c) B   d) Ge
5. In a metal, if the temperature increases then the resistivity
   a) Increases b) Decreases c) Remains same d) Fluctuates   (C.O.1) [Knowledge]
6. The temperature at which a material undergoes transition from normal state to superconducting state by losing its resistivity is called   (C.O.1) [Knowledge]
   a) Critical Temperature b) Absolute Temperature c) Curie Temperature
   d) Crystallization temperature
7. A semiconductor has ………… temperature coefficient of resistance.
                                                                   (CO2) [Knowledge]
   a) Negative   b) Zero   c) Positive   d)   None of the above
8. Silicon has ……………… valence electrons.   (CO2) [Knowledge]
      a) 2   b)   4   c)   6   d)   3
9. Which of the following formulas can be used to determine the de Broglie wavelength?
                                                                   (C.O.3) [Knowledge]
   a) $\lambda = hmv$ b) $\lambda = h/mv$ c) $\lambda = mv/h$ d) $\lambda = hm/c$
10. Which one of the following objects, moving at the same velocity, has the greatest de Broglie wavelength?   (C.O.3) [Knowledge]
    a) Electron b) Golf ball c) Football d) Tennis ball
11. The de Broglie wavelength of a sub-atomic particle is given by,   (C.O.3) [Knowledge]
    a) $h/\sqrt{2mE}$ b) $m/\sqrt{2hE}$ c) c/λ d) none of the above

12. Which diode is used as a Voltage regulator?   (C.O.2) [Knowledge]
    a) Zener Diode   b) LED   c) Photodiode d) all
13. The device which converts optical energy to electrical energy   (C.O.2) [Knowledge]
    a) Solar cell b) Resistor c) Capacitor d) Transistor
14. A surface that absorbs all the radiations falling on it is known as

                                                                        (CO3) [Knowledge]

    a) Calorie meter b) white body c) Thermistor d) Black body

15. Identify the characteristic of wave.   (CO3) [Knowledge]
    a) Wavelength b) Amplitude   c) frequency   d) all
16. If Hall coefficient is negative, the material is identified as
    a) Intrinsic semiconductor b) n-type semiconductor c) p-type semiconductor
    d) Can't be determined   (C.O.1) [Knowledge]
17. Energy band gap is highest in   (C.O.1) [Knowledge]
    a) Semiconductors b) Metals c) Insulators d) Superconductors
18. If Hall coefficient is negative, the material is identified as
    a) Intrinsic semiconductor b) n-type semiconductor c) p-type semiconductor
    d) Can't be determined   (C.O.1) [Knowledge]
19. Energy band gap is highest in   (C.O.1) [Knowledge]
    a) Semiconductors b) Metals c) Insulators d) Superconductors
 20. If the momentum of a particle is increased four times, then the de Broglie
     wavelength becomes
     a) twice b) four times c) one-fourth d) half   (C.O.3) [Knowledge]

Part B [Thought Provoking Questions]

Answer all the Questions. Each question carries 10 marks.   (2Qx10M=20M)
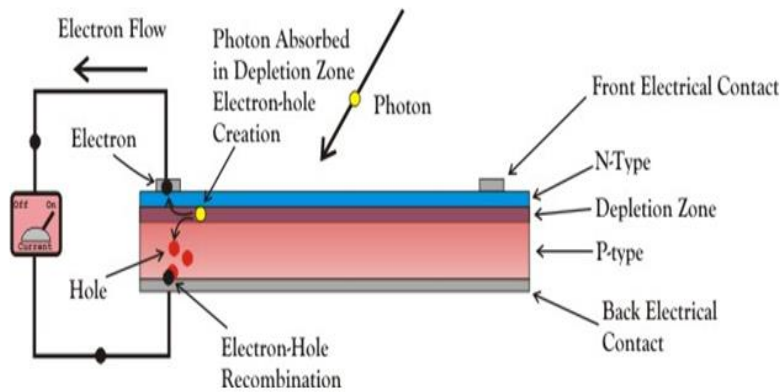
21.

Fig. 1

a) Identify the device in the picture (Fig 1). Explain the principle, construction and working of
    it.   (7 Marks)   (C.O.2) [Comprehension]

b) Derive an expression for de Broglie wavelength in terms of energy of the particle.
                                           (3 marks)   (C.O.3) [Comprehension]

22. Is it possible to formation of P-N junction without doping. Explain the formation of P-type and
    N-type semiconductor   (10 marks)   (C.O.1) [Comprehension]

Part C [Problem Solving Questions]

Answer all the Questions. Each question carries 15 marks.   **(2Qx20M=40M)**

23. a) In the following chart calculate the values of wavelength emitted by LED using the relevant
formula.   (10 Marks)   (C.O.2) [Application]

Band gap of material (eV)	Wavelength (nm)
1.5	
2.76	
1.93	

b) Explain the working principle of LED.   (3 Marks)   (C.O.2) [Application]

c) Identify the type of diode from the following V-I characteristics diagram (Fig 2).   Explain
knee voltage and breakdown voltage in it. (4 Marks)   (C.O.2) [Application]
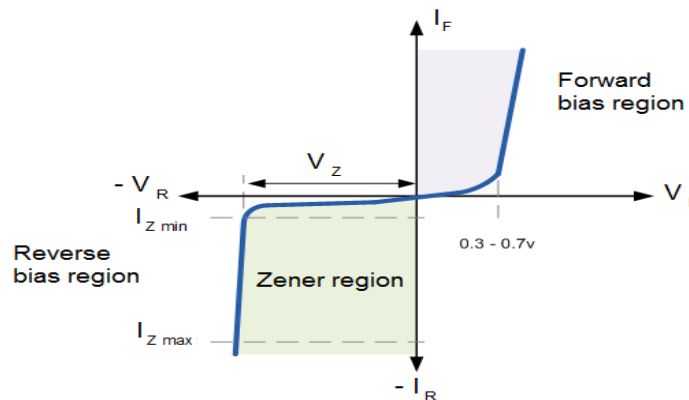

Fig. 2

d) Explain the breakdown mechanism for this diode. (3 marks)   (C.O.2) [Application]

24. (a)   C, Sn, Si, Ge are present in the same group but Si and Ge are semiconductors while C
and Sn are not. State the reasons?   (C-Band gap-5.2 eV, Si-Band gap-1.1 eV, Ge-Bandgap-
0.7 eV, Sn-Energy bap-0 eV).   (10M)   (C.O.1) [Application]

(b) The de-Broglie wavelength associated with a moving electron is 0.7753 Å. Calculate the
potential through which the electron undergoes acceleration. (6 marks)   (C.O.3) [Application]

(c) Why Type-1 superconductors cannot be used as permanent magnets.
                                    (4 marks)   (C.O.1) [Application]