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**PRESIDENCY UNIVERSITY
BENGALURU**

**SCHOOL OF ENGINEERING
END TERM EXAMINATION - JUN 2023**

Semester : Semester II - 2022

Course Code : PHY1002

Course Name : Sem II - PHY1002 - Optoelectronics and Device Physics

Program : CAI,COM,CSE&CSG

Date : 12-JUN-2023

Time : 1.00PM - 4.00PM

Max Marks : 100

Weightage : 50%

Instructions:

- (i) Read all questions carefully and answer accordingly.
 - (ii) Question paper consists of 3 parts.
 - (iii) Scientific and non-programmable calculator are permitted.
 - (iv) Do not write any information on the question paper other than Roll Number.
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PART A

ANSWER ALL THE QUESTIONS

(15 X 2 = 30M)

1. If the momentum is doubled, how the de Broglie wavelength changes?
(CO3) [Knowledge]
2. Define Fermi Level.
(CO2) [Knowledge]
3. Whether we should increase or decrease the bandgap of LED if one is interested in blue light instead of red light.
(CO2) [Knowledge]
4. Two particles A and B have masses 'm' and '9m' are moving with same kinetic energies, Find the ratio of de Broglie wavelength between particle A and B.
(CO3) [Knowledge]
5. What is population inversion?
(CO4) [Knowledge]
6. Define doping and write any two doping materials.
(CO1) [Knowledge]
7. Two particles A and B have masses 'm' and '4m' are moving with same velocities, then how many times is the de Broglie wavelength of the particle A to the particle B.
(CO3) [Knowledge]
8. Charge carriers in conductors are called electrons. What is the name of the charge carriers in superconductors? Write about the charge carriers in superconductors, their momentum and their spin.
(CO2) [Knowledge]

9. Draw the circuit symbols of Zener diode and LED indicating the p and n sides. (CO2) [Knowledge]
10. Define Critical Temperature. (CO1) [Knowledge]
11. How long an atom can stay in normal excited energy state? (CO4) [Knowledge]
12. What is spontaneous emission of light? (CO4) [Knowledge]
13. According to Heisenberg's Uncertainty Principle, the product of uncertainty in position and momentum is greater than or equal to which factor? (CO3) [Knowledge]
14. In which energy state atoms can stay for millisecond duration? (CO4) [Knowledge]
15. Define the Hall effect. (CO1) [Knowledge]

PART B

ANSWER ALL THE QUESTIONS

(4 X 10 = 40M)

16. a. Discuss the Fermi level positions in intrinsic, n-type and p-type semiconductors with suitable diagram.
 b. A semiconducting crystal with 10 mm long, 6 mm wide and 2 mm thick has a magnetic density of 0.7 Wbm^{-2} applied from front to back perpendicular to largest faces. When a current of 25 mA flows length wise through the specimen, the voltage measured across its width is found to be $40 \mu\text{V}$. What is the Hall coefficient of this semiconductor? (CO1) [Comprehension]
17. a. Identify the optical semiconductor device which emits light when voltage is applied. Explain its construction and working principle.
 b. Differentiate between zener diode and ordinary diode. What is the difference between their breakdown mechanisms? (CO2) [Comprehension]
18. a. Derive an expression for de Broglie wavelength in terms of energy of the particle.
 b. Find the de Broglie wavelength of an electron having K.E. $1.6 \times 10^{-19} \text{ J}$.
 c. The trotting speed of an elephant is 12 m/s. Calculate the associated de Broglie wavelength. (Mass of the elephant = 1200 kg). (CO3) [Comprehension]
19. a. Define the principle of an optical fiber and explain it with suitable diagram.
 b. LASER and Conventional Light are examples of which emission of radiation. Distinguish between those emissions. (CO4) [Comprehension]

PART C

ANSWER ALL THE QUESTIONS

(2 X 15 = 30M)

20. a. Compute the de Broglie wavelength for a neutron moving with one tenth part of the velocity of light. Mass of neutron is 1.674×10^{-27} Kg.
b. An electron and a cricket ball are travelling at 280 m/s measured to an accuracy of 0.09%. Calculate and compare the uncertainty in position of each body. Given mass of cricket ball is 250 gm and mass of electron is 9.1×10^{-31} kg.
c. If a GaAsP laser emits laser light at 671 nm, find the energy band-gap.
- (CO2,CO3) [Application]
21. a. The intrinsic carrier density is $1.7 \times 10^{16} m^{-3}$. If the mobility of electron and hole are $0.16 m^2 V^{-1} s^{-1}$ and $0.07 m^2 V^{-1} s^{-1}$, Estimate the conductivity.
b. An optical fiber is having a core material with refractive index 1.55 and its cladding material has refractive index 1.5. Calculate the numerical aperture.
c. Find the ratio of population of two energy levels in a medium in thermal equilibrium, if the wavelength of light emitted at 330K is 633 nm.

(CO4,CO1) [Application]