Roll No										

PRESIDENCY UNIVERSITY BENGALURU

SET B

SCHOOL OF ENGINEERING

END TERM EXAMINATION - JAN 2024

Semester : Semester I - 2023
Course Code : PHY1002
Course Name : Optoelectronics and Device Physics
Program : B.Tech.

Date : 13-JAN-2024
Time : 9:30AM - 12:30 PM
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.
(v) Given: $k=1.38\times10^{-23}$ J/K, $h=6.626\times10^{-34}$Js, $m_e=9.1\times10^{-31}$kg and $c=3\times10^{8}$m/s.

PART A

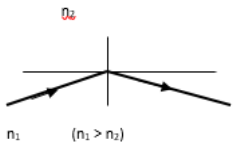
ANSWER ALL THE QUESTIONS **4 X 5M = 20M**

1. State and explain Heisenberg's uncertainty principle.
(CO3) [Knowledge]
2. What are matter waves? Mention their properties.
(CO3) [Knowledge]
3. Discuss the possible ways through which radiation and matter interaction can take place.
(CO4) [Knowledge]
4. Differentiate p type and n type semiconductors.
(CO1) [Knowledge]

PART B

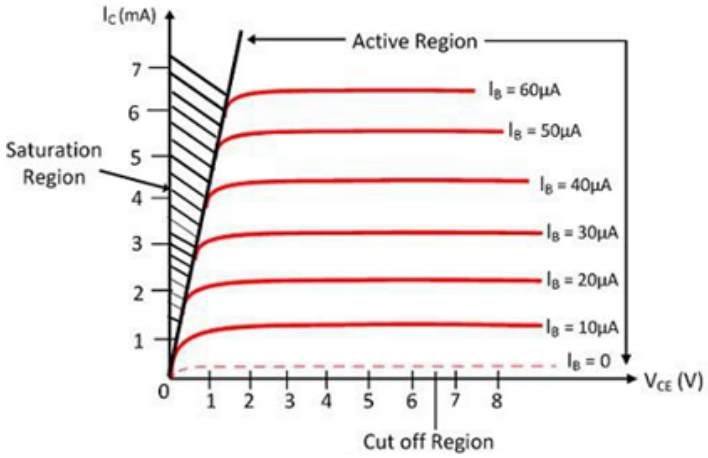
ANSWER ALL THE QUESTIONS **5 X 10M = 50M**

5. a) Explain the phenomenon represented in the below figure.



b) Compute the de Broglie wavelength for a neutron moving with one fifth part of velocity of light, given mass of neutron = 1.674×10^{-27} kg.
(CO4,CO3 [Comprehension]

6. A graph of output current on one axis and output voltage on another, at a constant input current is called the output characteristics of a transistor. The output characteristic for a common emitter transistor is shown in the given figure. Use the graph to find out the current amplification factor for the transistor when $V_{CE} = 5V$, $\triangle I_B$ = 30 mA. Draw a neat labelled diagram to represent the input characteristics of the common emitter transistor configuration.



(CO2) [Comprehension]

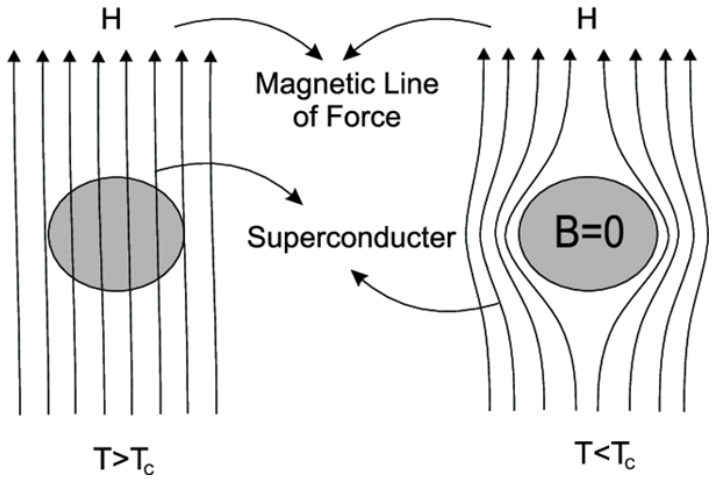
7. a) Show that the de Broglie wavelength for an electron accelerated by a potential difference V volt is

$$\lambda = \frac{1.226nm}{\sqrt{V}}$$

b) Calculate the numerical aperture and acceptance angle in an optical fibre. Given the refractive indices of core and cladding are 1.48 and 1.47 respectively.

(CO3,CO4) [Comprehension]

8. a) Explain the concept represented by the following figure.



b) The band gap between the valence and the conduction bands in zinc oxide (ZnO) is 3.12 eV. Suppose an electron in the conduction band combines with a hole in the valence band, the excess energy is released in the form of electromagnetic radiation. Find the maximum wavelength that can be emitted in this process. What will be the color of light emitted?

(CO1,CO2) [Comprehension]

9. a) Calculate the de Broglie wavelength associated with an electron accelerated under a potential difference of 150 V.

b) The ratio of population of two energy levels is 1.46×10^{-30}. Calculate the wavelength of light emitted at the thermal equilibrium temperature of 30^0C.

(CO3,CO4) [Comprehension]

PART C

ANSWER ALL THE QUESTIONS **2 X 15M = 30M**

10. a) Compare the energy of a photon with that of a neutron when both are associated with a de Broglie wavelength of 3.5 Å. Given mass of neutron is 1.674×10^{-27} kg.
b) The position and momentum of a 15 k e V electron are determined simultaneously. If its position is located within 2 Å, what is the percentage uncertainty in its momentum?

(CO3) [Application]

11. It is observed that a pn junction device develops meaningful voltage when exposed to sunlight. Identify the device. Explain the construction, principle, working and V-I characteristics of the device with necessary diagrams.

(CO2) [Application]