Hall Ticket Number:

Code No. : 12023 N (C)

VASAVI COLLEGE OF ENGINEERING *(Autonomous)*, HYDERABAD

B.E. (CBCS) II-Semester Main Examinations, May/June-2019

Quantum Mechanics and Semiconductor Physics

(EEE and ECE)

Time: **3** hours Max. Marks: **60**

*Note: Answer **ALL** questions in **Part-A** and any **FIVE** from **Part-B***

Q.No.	Stem of the question	M	L	CO	PO
	Part-A (10 × 2 = 20 Marks)				
1.	What is photo electric effect? On what factors do the emitted photo electrons depend?	2	2	1	1,2,12
2.	Calculate the uncertainty in the velocity of an electron which is confined in a 10A° box.	2	3	1	1,2,12
3.	Explain Born interpretation of wave function.	2	2	1	1,2,12
4.	Write a short note on α –decay.	2	2	1	1,2,12
5.	Compute the relaxation time of conduction electrons in a metal of resistivity 1.54×10^{-8} Ω-m if the metal has 5.8×10^{28} conduction electrons /m^3.	2	3	2	1,2,12
6.	What are the salient features of Fermi-Dirac statistics?	2	2	2	1,2,12
7.	With increase of temperature the conductivity of semiconductor increases while that of metals decreases. Give reasons.	2	3	3	1,2,12
8.	For a semiconductor the Hall coefficient is -3.66×10^{-11} m^3/C, and electrical conductivity is 112×10^7 m^{-1} Ω^{-1}.Calculate the density and mobility of charge carriers at room temperature.	2	3	3	1,2,12
9.	Write down the equation for total current density for electrons and holes due to drift and diffusion.	2	3	3	1,2,12
10.	Explain the conditions required for the formation of Schottky junction and Ohmic Junction.	2	3	3	1,2,12
	Part-B (5 × 8 = 40 Marks)				
11. a)	Describe the experimental verification of matter waves using Davisson-Germer's experiment	5	2	1	1,2,12
b)	Electrons are accelerated by through 344 volts and are reflected from a crystal. The first reflection maximum occurs when glancing angle is 60°. Determine the spacing of the crystal.	3	3	1	1,2,12
12. a)	Set up Schrödinger wave equation for a particle in a potential well of infinite depth and solve it for finding the eigen values and eigen functions.	6	3	1	1,2,12
b)	A particle is moving in a one dimensional box of width 30A°. Calculate the probability of finding the particle within an interval of 2A° at the centre of the box, when it is in its state of least energy.	2	3	1	1,2,12
13. a)	Obtain the expression for Density of States for a bulk material of volume V.	5	2	2	1,2,12
b)	With the help of suitable examples, compare direct and indirect band gap semiconductors.	3	2	2	1,2,12

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14. a)	Examine the variation of Fermi level with temperature both in n-type and p-type semiconductors.	5	2	3	1,2,12
b)	Explain Hall Effect and obtain an expression for mobility of charge carriers.	3	3	3	1,2,12
15. a)	Narrate the formation of PN junction under equilibrium with its band diagram.	4	2	3	1,2,12
b)	Arrive at the equation of continuity for electrons and holes of a semiconductor.	4	3	3	1,2,12
16. a)	What is Compton effect? Compute the wavelength of gamma radiation having photon energy 510keV is incident on a foil of aluminum at 90°.	4	3	1	1,2,12
b)	Derive Schrödinger time independent wave equation for a free particle.	4	2	1	1,2,12
17.	Answer any ***two*** of the following:				
a)	Discuss the conclusions of Kronig-Penney model.	4	2	2	1,2,12
b)	Show that for a p-type semiconductor the Hall coefficient is $R_H = \frac{1}{pe}$	4	2	3	1,2,12
c)	With the help of suitable equations, define diffusion length and mean life time. Find the diffusion coefficient and diffusion length of electrons in silicon at 300K if $\mu_e = 0.19\ m^2V^{-1}s^{-1}$.	4	3	3	1,2,12

M: Marks; L: Bloom's Taxonomy Level; CO: Course Outcome; PO: Programme Outcome

S. No.	Criteria for questions	Percentage
1	Fundamental knowledge (Level-1 & 2)	60%
2	Knowledge on application and analysis (Level-3 & 4)	40%
3	*Critical thinking and ability to design (Level-5 & 6) (*wherever applicable)	-

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