BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(END SEMESTER EXAMINATION)

CLASS: I.MSc/MSc **SEMESTER : IX/II**
BRANCH: Physics **SESSION : MO/2023**

SUBJECT: PH510 PHYSICS OF LOW DIMENSIONAL SEMICONDUCTORS

TIME: 3 Hours **FULL MARKS: 50**

INSTRUCTIONS:
1. The question paper contains 5 questions each of 10 marks and total 50 marks.
2. Attempt all questions.
3. The missing data, if any, may be assumed suitably.
***4*. Before attempting the question paper, be sure that you have got the correct question paper.**
5. Tables/Data hand book/Graph paper etc. to be supplied to the candidates in the examination hall.

			CO	BL
Q.1(a)	Show that density of states for 1D structure is $D(E) \propto E^{-1/2}$ and for 2D structures is $D(E) \propto E^{0}$. Graphically show the variation of density of states with respect to E?	[5]	1	5
Q.1(b)	Outline how the reduced dimensionality of semiconductors for miniaturized devices put new challenges in terms of physical laws?	[5]	1	4
Q.2(a)	Write a short note on "Metal organic chemical vapor deposition". Discuss the case of growth of GaAs?	[5]	2	1
Q.2(b)	Sketch the band diagram for a hetro-junction between p-type AlGaAs and n-type GaAs. Show that this can trap a (two-dimensional) hole gas at the interface?	[5]	2	3
Q.3(a)	For a parabolic potential well (grown in both conduction and valence bands into GaAs by a graded composition) of $Al_xGa_{1-x}As$ show that the energy levels are equispaced?	[5]	3	2
Q.3(b)	Plot a graph of the energy of the bound states in a GaAs well 0.3 eV deep as a function of width from 0 to 30 nm?	[5]	3	6
Q.4(a)	Describe the concept of T-matrix for potential well problems? Calculate the tunnelling probability across a square barrier of height V_o $T = \frac{16E}{V_o}\exp(-2K_2 a)$	[5]	4	3
Q.4(b)	Describe construction and working of a Near-field scanning probe microscope?	[5]	4	3
Q.5(a)	Write a short note on Physics of 2-dimensional materials and their applications?	[5]	5	4
Q.5(b)	Discuss the concept of modulation doping?	[5]	5	2

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