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SARDAR PATEL UNIVERSITY

M.Sc. (Electronics) First Semester Examination (Under CBCS)

October, 2018

PS01CELE21: Semiconductor Science and Devices

Monday, October 22, 2018 Time: 10.00 a.m. to 1.00 p.m. Total Marks: 70

Q. 1	Give the correct (nearest) answer (statement) to the following Multiple Choice Questions (Statements):	8x1 = [8]

(1) For a quantum mechanical particle moving in periodic potential well, the discontinuities in the E versus K curve occur for
(a) $K = n\pi/a$ (c) $K = n\pi/2a$
(b) $K = 4\pi/a$ (d) none of these

(2) When the electron in a crystal is accelerated in the direction to the action of external force and its velocity changes from zero to a maximum positive value, its effective mass
(c) changes from $-m_p$ to infinity (c) remains constant
(d) Is equal to m_n (d) changes from m_n to infinity

(3) From the Kronig Penney Model, it can be concluded that when the Binding Energy P = ∞ (infinity), the energy spectrum is
(a) continuous (c) discontinuous
(b) a line spectrum (d) piece wise

(4) The equation $g(E) = [4\pi(2m_n)^{3/2}. E^{1/2}]/h^3$ is the density of states function for
(a) The bottom of the energy band (c) Fermi level
(b) The top of the energy band (d) none of these

(5) Ohmic contact is also known as
(a) Rectifying Contact (c) Non Rectifying Contact
(b) Non Ohmic contact (d) None of these

(6) In Np hetero junction,
(a) Eg1 > Eg2 (c) Eg1 = Eg2
(b) Eg1 < Eg2 (d) All of these

(7) Solar cell is an example of
(a) Photoconductive cell (c) Photo emissive cell
(b) Photovoltaic cell (d) None of these

(8) LED is based on the principle of
(a) Injection Luminescence (c) Photo Luminescence
(b) Thermo Luminescence (d) Chemi Luminescence

(P.T.O.)

Q. 2	Give short answers to the following: (any seven) 1. For a simple cubic lattice with N particles show the total number of possible wave functions and the number of states. 2. Discuss the concept of a 'hole' using band diagram. 3. Prove that 'the velocity of a single electron' is same as 'the group velocity'. 4. Describe the Fermi Energy and show the probability of finding an electron at Fermi Level. 5. Describe how the Hall effect can distinguish between n-type and p-type semiconductors. 6. Differentiate between Rectifying and Ohmic Contacts. 7. Discuss briefly about Interface traps and Charges. 8. What Is a heterojunction ? Classify it. Draw the Band structure for any one type. 9. Explain briefly the working of Semiconductor LASER.	7x2 = [14]
Q.3 (a)	Explain with necessary diagrams the collectivization of electrons in a crystal and formation of bands.	[6]
(b)	For a quantum mechanical particle moving in periodic potential describe the effect on the width of the allowed energy band with (i) increasing energy (αa) and (ii) increasing the binding energy of electrons (P). Show with necessary figure the extreme conditions of P.	[6]
	OR	
(b)	Differentiate between the between the motion of a quantum mechanical particle when (1) free and (3) moving through a periodic potential.	[6]
Q.4 (a)	What is Hall Effect? Deduce the equation of Hall constant.	[6]
(b)	Using appropriate equations, show the position of Fermi Level and its variation with temperature for intrinsic and extrinsic (n-type) semiconductors.	[6]
	OR	
(b)	Explain how the Band Diagram can be used to distinguish between metal, semiconductor and Insulator.	[6]
Q.5 (a)	Explain the Process of Accumulation, Depletion and Inversion in context with the MIS structure.	[6]
(b)	Describe the process of Absorption of Photon Energy in Semiconductor.	[6]
	OR	
(b)	With proper biasing conditions, explain the working principle of Rectifying Metal - n type Semiconductor contact.	[6]
Q.6 (a)	What is a Solar Cell? Explain the principle of working and various types of Solar Cells.	[6]
(b)	What is an LED? Explain with proper schematics, the working of an LED.	[6]
	OR	
(b)	List different Display devices. Explain the principle of Plasma Display.	[6]