Faculty of Science

End Sem (Even) Examination May-2019

BC3EP08 Solid State Physics and Devices

Programme: B.Sc. (CS)   Branch/Specialisation: Computer Science

Duration: 3 Hrs.   **Maximum Marks: 60**

Note: All questions are compulsory. Internal choices, if any, are indicated. Answers of Q.1 (MCQs) should be written in full instead of only a, b, c or d.

Q.1   i.   In a simple cubic system, a unit cell has   **1**
     (a) 1 molecule   (b) 4 molecules
     (c) 8 molecules   (d) 12 molecules

   ii.   According to the free electron model, the average kinetic energy of   **1**
electron at an absolute temperature T is:
     (a) Zero   (b) $\frac{1}{2}kT$ (c) $\frac{3}{2}kT$ (d) Infinite

   iii.   The energy of phonon is: **1**
     (a) $\hbar k$ (b) $\hbar v$ (c) ka (d) $\hbar\omega$

   iv.   The Curie law holds for: **1**
     (a) Diamagnetic substances   (b) Paramagnetic substances
     (c) Ferromagnetic substances (d) Ferrimagnetic substances

   v.   Zener diode is always used as: **1**
     (a) Voltage regulator   (b) Rectifier
     (c) Voltage amplifier   (d) Oscillator

   vi.   In CE mode transistor, the output is obtained from: **1**
     (a) Emitter – Base junction   (b) Collector - Emitter junction
     (c) Base – Emitter junction   (d) Collector – Base junction

   vii.   The current gain in CB and CE mode is, respectively: **1**
     (a) α and β   (b) α and (β+1)
     (c) (α+1) and β   (d) β and α

   viii.   The essential condition for an oscillator is: **1**
     (a) $B = A$ (b) $|1 - BA| > 0$
     (c) $|1 - BA| < 0$ (d) $B = {}^{1}/_{A}$

ix. The structure of a spherical particle of radius 10 nm will be: **1**
(a) 3D   (b) 0D   (c) 1D   (d) 2D

x. Which of the following method is used to determine the energy band gap of nano materials: **1**
(a) XRD   (b) SEM   (c) UV-Vis   (d) TEM

Q.2   i. What is a unit cell? **2**

ii. Differentiate between the crystalline and non-crystalline solids. **3**

iii. Define Miller Indices. Write the method of finding the Miller indices of a lattice plane. Find the Miller indices for a lattice planes of a crystal having intercepts at 2*a*, 3*b* and 6c on the axes **5**

OR   iv. Draw the energy bands for solids. Give the conclusion of the Kronig – Penny model. **5**

Q.3   i. In a linear lattice, find the cut off frequency assuming that the interatomic distance is 3Å and the speed of elastic waves in it is 3×10^3 m s^{-1}. **2**

ii. Write any three postulates of Debye theory of specific heat of solids. **3**

iii. What is Hall effect? Obtain the expression for the Hall coefficient and Hall voltage of a solid. **5**

OR   iv. Differentiate between the paramagnetic, diamagnetic and ferromagnetic substance. **5**

Q.4   i. What is breakdown in diodes? Write the name of breakdowns which occur in the junction diode. **2**

ii. Draw the symbol of the NPN and PNP transistor. Why NPN transistor is more useful than PNP transistor? **3**

iii. What do you mean by rectification? Draw the circuit diagram of full wave rectifier. Obtain the expression for its efficiency and ripple factor. **5**

OR   iv. What is Solar cell? Explain its construction and working. Where it is used? **5**

Q.5   i. Draw the frequency response curve for R-C coupled amplifier. **2**

ii. Write the principle of the voltage feedback. **3**

iii. What is an amplifier? Draw the biasing circuit diagram and the ac equivalent circuit of a single stage small signal CE amplifier. **5**

OR   iv. What is an oscillator? Establish the Bark – Hausen condition for an oscillator and explain the different requirement for an oscillator. **5**

Q.6   i. Differentiate between Bottom up and Top down approach. **2**

ii. Write the principle of UV-Vis spectrophotometer. **3**

iii. Differentiate between the bulk and nanomaterials on the basis of the following properties: **5**
(a) Size   (b) Structure   (c) Colour
(d) Hardness   (e) Solubility

OR   iv. Write a brief note on the characterization method of nano materials which provides the information regarding the crystal structure. **5**

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Marking Scheme
BC3EP08 Solid State Physics and Devices

Q.1

i. In a simple cubic system, a unit cell has **1**
   (a) 1 molecule

ii. According to the free electron model, the average kinetic energy of electron at an absolute temperature T is: **1**
    (c) $\frac{3}{2}kT$

iii. The energy of phonon is: **1**
     (d) $\hbar\omega$

iv. The Curie law holds for: **1**
    (b) Paramagnetic substances

v. Zener diode is always used as: **1**
   (a) Voltage regulator

vi. In CE mode transistor, the output is obtained from: **1**
    (b) Collector - Emitter junction

vii. The current gain in CB and CE mode is, respectively: **1**
     (a) α and β

viii. The essential condition for an oscillator is: **1**
      (d) $B = \frac{1}{A}$

ix. The structure of a spherical particle of radius 10 nm will be: **1**
    (b) 0D

x. Which of the following method is used to determine the energy band gap of nano materials: **1**
   (c) UV-Vis

Q.2

i. Definition of unit cell **2**

ii. Differentiate b/w the crystalline and non-crystalline solids. **3**
    Any three difference 1 mark for each   (1 mark * 3)

iii. Define Miller Indices   1 mark   **5**
     Method of finding the Miller indices   2 marks
     Numerical   2 marks

OR iv. Draw the energy bands for solids   2 marks   **5**
           Conclusion of the Kronig – Penny model
           At least 3 points   3 marks

Q.3

i. Formula   1 mark   **2**
   Answer   1 mark

ii. Any three postulates of Debye theory of specific heat of solids.   **3**
    1 mark for each postulates   (1 mark * 3)

iii. Definition of Hall effect   1 mark   **5**
     Derivation for the Hall coefficient   2 marks
     Derivation for the Hall voltage of a solid   2 marks

OR iv. Differentiate b/w paramagnetic, diamagnetic and ferromagnetic   **5**
           substance.
           1 mark for each difference   (1 mark * 5)

Q.4

i. Definition of breakdown in diodes   1 mark   **2**
   Name of breakdowns in the junction diode   1 mark

ii. Symbol of the NPN transistor   1 mark   **3**
    Symbol of the PNP transistor   1 mark
    Difference b/w both   1 mark

iii. Rectification   1 mark   **5**
     Circuit diagram of full wave rectifier   2 marks
     Expression for its efficiency   1 mark
     Expression for its ripple factor.   1 mark

OR iv. Principle of Solar cell   1 mark   **5**
           Diagram   1 mark
           Construction   1 mark
           Working   1 mark
           Uses   1 mark

Q.5

i. Frequency response curve for R-C coupled amplifier   **2**
   Diagram   1 mark
   Axes   1 mark

ii. Principle of the voltage feedback   **3**
    1 mark for each point   (1 mark * 3)

iii. Amplifier   1 mark   **5**
     Circuit diagram   1 mark
     Ac equivalent Diagram   1 mark
     Description of working   2 marks

OR	iv.	Oscillator	2 marks	**5**
		Bark – Hausen condition for an oscillator	1 mark	
		Different requirement for an oscillator	2 marks	

Q.6	i.	Differentiate between Bottom up and Top down approach.		**2**
		Any differences 1 mark for each	(1 mark * 2)	
	ii.	Principle of UV-Vis spectrophotometer.	1 mark	**3**
		Diagram	2 mark	
	iii.	Differentiate between the bulk and nanomaterials		**5**
		0.5 mark for each property of bulk		
		(0.5 mark * 5)	2.5 marks	
		0.5 mark for each property of nanomaterial		
		(0.5 mark * 5)	2.5 marks	
OR	iv.	XRD method	1 mark	**5**
		Diagram	2 marks	
		Principle	2 marks	

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