

B.E. ELECTRONICS AND TELE-COMMUNICATION ENGINEERING EXAM 2019 (OLD)

FIRST YEAR FIRST SEMESTER

PHYSICAL ELECTRONICS

Time: 3 hours

(All parts of the same question must be answered together) **Full Marks: 100**

*Answer **Question no. 1** and **any SEVEN** from the rest.*

- | | | |
|------|--|-----|
| 1. | Explain (<i>any SIX</i>): | 6x5 |
| | a) Compound semiconductor | |
| | b) Unit cell | |
| | c) Cubic lattice | |
| | d) Free electron theory of metals | |
| | e) Carrier effective mass | |
| | f) Einstein relation | |
| | g) Life time of minority carriers | |
| | h) Ionized impurity scattering. | |
| 2.a) | Determine the variation of potential energy of an electron with distance along a one-dimensional mono-atomic crystal and construct the corresponding Kronig-Penney model. | 3+2 |
| b) | State and explain Bloch Theorem. | 5 |
| 3. | Construct the general time-dependent Schrödinger equation with the help of relevant quantum mechanical operators. Derive its time-independent form. | 5+5 |
| 4. | Determine the wave function for an electron confined in an infinitely deep potential well. | 10 |
| 5. | Establish the energy dependence of density-of-states function $D(E)$ for electrons in the conduction band of a semiconductor system, assuming the $E-k$ relation to be parabolic. Also sketch variation of $D(E)$ with E . | 8+2 |
| 6. | Derive an expression for concentration of electrons in the conduction band of a non-degenerate semiconductor. | 10 |
| 7. | Describe how you can obtain an n -type semiconductor from an intrinsic one. Also express location of the Fermi level in terms of electron concentrations in the above two semiconductors. | 6+4 |

8. What is phonon? Compare the features of *Acoustic phonon* and *Optic phonon*. 2+8
9. Formulate the continuity equation for excess electrons in a *p*-type semiconductor, and modify it under steady state minority carrier injection. 7+3
10. Describe Hall experiment and the scheme for determining majority carrier concentration and conductivity type of the given semiconductor sample. 10
11. Write note on (*any ONE*): 1x10
- a) Recombination of carriers,
 - b) Temperature dependence of Carrier concentration in extrinsic semiconductor,
 - c) Experimental determination of Carrier effective mass.