B.E. Electronics and Tele-Communication Engineering Supplementary Examination 2018

(First Year - First Semester)

PHYSICAL ELECTRONICS

Full Marks: 100 Time: Three hours

The figures in the margin indicate full marks.
(All parts of the same question must be answered together)

Answer ***Q.1*** and ***any eight*** from the rest.

1. Answer all of the following: 20

a) Names of different cubic lattices are ----, ---- and ----.
b) Crystal structure is described as combination of ---- and ----.
c) Most common examples of elemental semiconductors are ---- and ----.
d) ---- is a direct band gap semiconductor, while ---- is an indirect band gap semiconductor.
e) With increase in temperature, the resistance offered by a semiconductor ----.
f) Name of the three valence bands are ----, ---- and ----.
g) Mass of a hole is ---- than that of an electron.
h) ---- Statistics suits for distinguishable particles.
i) A semiconductor behaves as an insulator at a temperature of ----.
j) For a chain of atoms with uniform separation of a, the reduced Brillouin zone extends for k values of ---- to ----.
k) For a semiconductor with wider band gap, intrinsic carrier concentration is ----.
A material that can behave both as donor and acceptor to a semiconductor is called ---- material.

2. Derive the expression of DOS function in a bulk semiconductor, where the E-k relation is assumed to be parabolic. Also write down the general energy dependence of DOS function for systems of different dimensions. 8+2

3. Write the form of 'Momentum operator' and 'Energy operator', and use them to formulate the general Schroedinger equation. Also derive its time-independent form. 4+6

4. An electron is confined in an infinite square well. Derive the wave function appropriate for it and find its energy Eigen values. 10

5. What is Fermi-Dirac distribution function? Establish its variation with energy for both zero and non-zero temperatures. What is meant by Fermi-Dirac tail? 2+6+2

6.a)	Derive Einstein relation and explain its significance.	5
b)	Calculate the diffusion coefficient of electrons at 300K in *n*-type *Si* doped with 10^{15} *P* atoms cm^{-3}. Given that electron mobility is 1300 cm^2/s.	5
7.	Describe how a *p*-type semiconductor can be converted to an *n*-type one by *compensation doping*. Also schematically illustrate the mechanism.	7+3
8.	Formulate the continuity equation for excess carriers and find out their distribution in presence of steady state carrier injection.	6+4
9.	Compare features and origin of *acoustic* and *optic* phonons.	10
10.	Draw and explain the temperature dependence of carrier concentration in an *n*-type semiconductor.	10
11.	Describe the set-up for Hall experiment and the scheme for determining the carrier concentration of majority carriers for a *p*-type semiconductor.	10