Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY
Manipal University

SIXTH SEMESTER B.Tech. (E & C) DEGREE END SEMESTER EXAMINATION
MAY/JUNE 2016
SUBJECT: INTRODUCTION TO NANOSCIENCE & TECHNOLOGY (ECE - 360)

TIME: 3 HOURS **MAX. MARKS: 50**

Instructions to candidates
- Answer **ANY FIVE** full questions.
- Missing data may be suitably assumed.

1A. Why and how hcp and FCC crystals are called closed packed structures?
1B. State and explain (with example) how miller indices are formulated.
1C. Calculate the number of atoms in a 1.4 nm diameter Pt nano particle. Given that bulk density is 21.5 grams/ cm^3. Atomic Weight of Pt is 195.

(3+3+4)

2A. Calculate the number of surface atoms and percentage of surface atoms in 2 nm diameter ε- cobalt nano crystal. Given that it forms a simple cubic structure with 6.097 Å edge.
2B. Derive an expression for binding energy of an exciton. And calculate Rydberg constant.

(4+6)

3A. Derive an expression for exciton Bohr radios of e-hole pair placed in a matrix of CdSe. Further calculate exciton Bohr radios and individual exciton Bohr radii in the CadS. Given that for CdS : $m_e = 0.2\ m_o$ and $m_h = 0.7\ m_o$ and $\varepsilon = 8.6$. Further for CaSe, $m_e = 0.13\ m_o$ and $m\ h = 0.45\ m_o$ and $\varepsilon = 9.5$. Comment on the result. For which material, quantum confinement is easier to achieve.

3B. Describe how can "near field- optical microscopy" be utilised to gain better resolution.

(7+3)

4A.
a) Exciton Bohr radios of Frenkel exciton is larger than Mott- Wannier exciton. Yes/No, explain.
b) How can melting of nano-particle be detected?
c) The spacing between two adjacent energy levels in a band is given by ----------
d) Thermal energy at room temperature (300 K) is ---
e) Epitaxial thin films are ------- films.
f) Chief advantage of TEM in characterising nanostructures is -------

4B. Compare and contrast optics of different types of microscopies with an aid of neat schematic.

(6+4)

5A. Describe chemical reactions involved in producing high quality Si starting from metallurgical grade Silicon.
5B. Describe with proper neat schematic, photolithography technique to fabricate sub-micron features. Explain different etching processes.
5C. Indicate the principles of different scanning probe microscopies developed so far.

(3+5+2)

6A. Explain growth modes of hetero-epitaxial systems and how they can be utilised to grow nanostructures.

6B. Explain different configurations in developing SNOM.

(5+5)