Reg. No.					
Reg. No.					Deg No
					Reg. No.

## MANIPAL INSTITUTE OF TECHNOLOGY Manipal University SIXTH SEMESTER B.Tech. (E & C) DEGREE END SEMESTER EXAMINATION -April/May 2017

SUBJECT: Introduction to Nanoscience and Technology (ECE - 360)

## **TIME: 3 HOURS**

MAX. MARKS: 50

Instructions to candidates

- Answer **ANY FIVE FULL** questions.
- Missing data may be suitably assumed.
- 1A. What are the close packed crystal structures and why?
- 1B. Calculate number of Ga and As atoms per cubic centimetre of GaAs crystal. Given that the lattice parameter of GaAs crystal is 5.95 Å and crystal is FCC.
- 1C. Explain the system of representation of different planes and crystal directions in a crystal.

(3+4+3)

- 2A. Derive an expression for binding energy of an exciton. And calculate Rydberg constant.
- 2B. Calculate binding energy of exciton in the following cases. Comment on the result.
  - a) For CdS : m  $_e$  = 0.2 m  $_o$  and m  $_h$  = 0.7 m  $_o~$  and  $\epsilon$  = 8.6
  - b) For InP :  $m_e = 0.07 m_o$  and  $m_h = 0.4 m_o$  and  $\epsilon = 14$ .
- 2C. Describe two parameters in characterising nanoscale dimensions in semiconductors for optical property

(5+3+2)

- 3A. Describe how can "near field- optical microscopy" be utilised to gain better resolution.
- 3B. Describe how the scanning tunnelling spectroscopy be utilised to estimate local density of states in a nanostructured materials. What type of materials be probed into by STM
- 3C. Describe chemical reactions involved in producing high quality Si starting from metallurgical grade Silicon.

(3+4+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 ---
- 4B. Describe the chemical reactions involved in extracting and refining the Si to its purest form. Describe how single crystals be formed by utilising that pure Si.

(5+5)

- 5A. Describe with proper neat schematic, photolithography technique to fabricate sub-micron features. Explain different etching processes.
- 5B. Why the nanostructures of the nobel metals exhibit different colours? Describe the underlying phenomenon and how it be realised.



- 6A. How can we utilise the hetero-epitaxial growth modes in realising nanostructures?
- 6B. Explain different configurations in developing SNOM.

(5+5)