Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

A Constituent Institution of Manipal University

SEVENTH SEMESTER B.Tech. (E & C) DEGREE END SEMESTER EXAMINATION
NOV 2017
SUBJECT: MATERIAL SCIENCE for MICRO AND NANOELECTRONICS (ECE - 443)

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

Instructions to candidates

- Answer **ANY FIVE** questions.
- Missing data may be suitably assumed.

1A. Indicate and explain with mathematical formulation why some crystal structures are said to be close packed structures?
1B. Calculate the number of atoms in 1.4 nm diameter Pt, using bulk density ρ= 21.5 grams / cm ^{3}
1C. List properties of quantum mechanical wave function.

(4+3+3)

2A. Derive an expression and calculate binding energy of lowest orbit of GaAs and InAs. Given that: For GaAs – $m_e = 0.067\ m_o$ and $m_h = 0.45\ m_o$ and $\varepsilon = 12.4$ and for InAs : $m_e = 0.02\ m_o$ and $m_h = 0.4\ m_o$ and $\varepsilon = 14.5$. Comment on the result.
2B. Calculate thermal voltage at 300^0K, 150^0K and 1.5^0 K. and comment on the result.

(6+4)

3A. Calculate the wave function and also energy of first three quantized energy levels for a particle confined in a quantum well of infinite potential walls.
3B. How can we define the crystalline, polycrystalline and amorphous materials?

(6+4)

4A. Answer all of the following

i) The solution for Schrodinger equation for a particle confined in all three dimensions in terms of Energy --------- and wave function ----------.
ii) The energy levels are quantised while the particle is moving in classically --- region and the wave function is exponentially decay while the particle is moving in classically ----- region.
iii) The dispersion relation for an electromagnetic wave travelling in a medium -------
iv) Density of energy states is defined as ----------
v) Buried nanostructures can be characterised by ---------- technique.
vi) The energy level spacing in metal nano-particles is given by ----------
vii) Mention the steps for producing high quality Si single crystals.

(2+2+1+1+1+1+2)

5A. Explain construction and modes of operation of AFM.
5B. Explain how color of a metal nanoparticles differ from that of bulk material.

(5+5)

6A. Explain the thin film growth modes in hetero-epitaxial process.
6B. Explain steps involved in photolithography technique.
6C. Explain what is Bohr radius and exiton Bohr radius and derive relation between them.

(2+5+3)