

(A constituent unit of MAHE, Manipal)

SEVENTH SEMESTER BTECH. (E & C) DEGREE END SEMESTER EXAMINATION DECEMBER 2020/JANUARY 2021 SUBJECT: NANOTECHNOLOGY (ECE - 4029)

TIME: 3 HOURS

MAX. MARKS: 50

Instructions to candidates

- Answer **ALL** questions.
- Missing data may be suitably assumed.
- 1A. While a given nano-meter sized object of a material is qualified for being "nano", a similar sized object of another material may not. Discuss this statement in the case of semiconductors.
- 1B. Calculate the number of atoms present in the 1.4 nm diameter Pt nanoparticle. Consider FCC unit cell with lattice constant 0.391 nm.
- 1C. Explain how crystal structures of materials can differ in terms of symmetry consideration

(4+3+3)

- 2A. Calculate the bulk exciton Bohr radius for GaAs and CdSe. Given the data: for GaAs, $m_e=0.067m_0$ and $m_h=0.45m_0$ and $\epsilon=12.4$ and for CdSe, $m_e=0.13m_0$ and $m_h=0.45m_0$ and $\epsilon=9.4$. Comment on the results
- 2B. What is deBroglie wave length of C_{60} moving at 60m/sec given the mass to be 720.66 grams/mol. Compare it with that for a baseball (0.15 Kg) moving at 50m/sec. Given that $h=6.62 \times 10^{-34}$ J.s. Draw meaningful conclusions.
- 2C. What is meant by "quantum confinement"? Discuss various low dimensional systems.

(4+3+3)

- 3A. With appropriate experimentation, explain how colour of metallic nanostructures change with their size, shape and aspect ratio.
- 3B. Explain how the nanomaterials can have anomalous melting points. Explain with an example of Au nanomaterial.
- 3C. With neat diagram, explain a methodology for preparation of carbon nanotubes. How the carbon nanotubes can be utilised for various purposes? What is the most important challenge in carbon nanotube research?

(4+3+3)

- 4A. With neat diagram, explain the principle of scanning tunnelling microscopy. What are the implications of the principle in constructing the STM?
- 4B. How AFM differs with STM? Explain the modes of operation of AFM.
- 4C. Describe various interactions between the AFM tip and sample atom

(4+3+3)

(4+3+3)

- 5A. Explain, how a graphene oxide can be prepared in a powder form.
- 5B. Single and bilayer graphene are zero gap semiconductors. Justify.
- 5C. Describe two techniques to obtain large area Graphene.