

Reg No.: _____

Name: _____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

Fourth Semester B.Tech (Hons) Degree Examination June 2022 (2020 Admn)

**Course Code: ECT292****Course Name: NANO ELECTRONICS**

Max. Marks: 100

Duration: 3 Hours

PART A*(Answer all questions; each question carries 3 marks)*

Marks

- | | | |
|----|--|---|
| 1 | Explain any two characteristic lengths in mesoscopic systems. | 3 |
| 2 | Define the term Quantum mechanical coherence. | 3 |
| 3 | Differentiate between dry and wet oxidation methods. | 3 |
| 4 | Explain Sol Gel process for fabrication of nano particles. | 3 |
| 5 | Compare Transmission Electron Microscopy (TEM) with Atomic Force Microscopy (AFM). | 3 |
| 6 | What are the two modes of operation used in Scanning Tunneling Microscopy (STM)? | 3 |
| 7 | What is meant by Zone folding? | 3 |
| 8 | Explain electron-phonon scattering mechanisms in parallel transport. | 3 |
| 9 | Write short notes on hot electron transistor. | 3 |
| 10 | Write short notes on quantum dot lasers. | 3 |

PART B*(Answer one full question from each module, each question carries 14 marks)***Module -1**

- | | | |
|----|---|---|
| 11 | a) Starting from Schrodinger equation, show that the density of states in a 1 D semiconductor material is directly proportional to $1/\sqrt{E}$ | 7 |
| | b) Model the energy levels of parabolic and triangular quantum wells. | 7 |
| 12 | a) Show that DOS in a 2D material is independent of energy. | 6 |
| | b) With suitable equations explain a square quantum well and also sketch the energy level diagram. | 8 |

Module -2

- | | | |
|----|--|---|
| 13 | a) Explain ion implantation process with necessary diagrams. | 8 |
|----|--|---|

- b) Illustrate the following processes with suitable diagrams. 6
- a) Grinding with Iron Balls
 - b) Gas Condensation
 - c) laser ablation.
- 14 a) Illustrate the process of Molecular Beam Epitaxy for fabricating nanolayers with relevant diagram. 8
- b) Compare evaporation and sputtering methods. 6

Module -3

- 15 a) Illustrate the working of Scanning Electron Microscope with relevant diagram. 10
- b) Explain the different emission and interactions between electron beam and the specimen. 4
- 16 a) Explain the working principle of Atomic Force Microscope. 7
- b) Explain the principle of operation of Scanning Tunneling Microscope. 7

Module -4

- 17 a) What is superlattice? Explain the Kronig-Penney model of a superlattice. 7
- b) What do you mean by coulomb blockade effect? What are the conditions to be met in order to observe coulomb blockade? 7
- 18 a) Explain quantum transport in nanostructures and give Landauer formula. 6
- b) Explain i) Aharonov-Bohm effect ii) the Shubnikov-de Hass effect 8

Module -5

- 19 a) Draw the schematic and explain the working of a single electron transistor 7
- b) Explain the properties of graphene. 7
- 20 a) With suitable diagram explain the operation of quantum well laser. 7
- b) Explain the working of resonant tunnel diode. 7
