

SEVENTH SEMESTER B.TECH DEGREE EXAMINATION

13.701 NANOELECTRONICS (AT)

Time: 3 Hours

Max. Marks: 100

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PART - A

(Answer all questions. Each question carries 2 marks.)

1. Explain Quantum mechanical coherence.
2. What are the advantages and disadvantages of Quantum dot lasers over Quantum well lasers?
3. Explain Characteristic lengths used in Mesoscopic systems.
4. List the advantages and disadvantages of CVD process.
5. What is the basic principle of NEMS?
6. What is the principle of operation of AFM?
7. Explain Heterojunctions.
8. Differentiate between parallel and perpendicular transport.
9. Define Resonant Tunnel Effect.
10. Write a note on Coulomb Blockade Effect.

PART - B

(Answer any one question from each Module.)

Module - I

11.
 - a. Explain the density of states in 2D, 1D and 0D materials.
(15 Marks)

 - b. Differentiate between Quantum wires and quantum dots. 5 Marks)

- 12.
- a. Determine the electron wave function for a finite potential square well (State all your assumptions clearly). (10 marks)
 - b. Obtain Density of states for a 2D semiconductor nanostructure. Compare the value with 1D semiconductor. (10 marks)

Module - II

- 13.
- a. Explain why annealing is required after ion implantation. (10 Marks)
 - b. Explain the process of Laser ablation. Highlight the advantages. (10 marks)
- 14.
- a. Differentiate between STM, AFM and SEM. (10 marks)
 - b. Describe the principles of PL and UV instruments. (10 marks)

Module - III

- 15.
- a. List and explain major electron scattering mechanisms in parallel transport. (10 Marks)
 - b. An $\text{AlGa}_{1-x}\text{As}/\text{GaAs}$ super lattice with $x=0.3$, a well width $a=10\text{nm}$ and barrier width $b=2.2\text{nm}$ and barrier height of $V_0=0.25\text{eV}$. Find the widths of mini bands and mini gaps that can exist within the barrier using Kronig-Penny models. (10 Marks)
- 16.
- a. Explain the Shubnikov-de Hass effect of Magnetic fields on the electronic and transport properties of 2D systems. (10 Marks)
 - b. Explain the Kronig-Penny model of s super lattice. What is meant by Zone folding? (10 Marks)

Module - IV

- 17.
- a. Explain how an electron well is formed in Heterojunctions? The electron mobility in MODFET is much higher than in MOSFETs. Why?
(10 Marks)
 - b. With relevant diagrams explain the working of single electron transistor. (10 Marks)
- 18.
- a. Explain the principle of operation of nanoelectronic switch made of a conducting molecule. (10 Marks)
 - b. Draw the schematic representation of conduction band of RTD for (a) no voltage applied (b) increasing applied voltage. Explain its I-V characteristics. (10 Marks)