

M.E. ELECTRONICS AND TELE-COMMUNICATION ENGINEERING, 2019

FIRST YEAR SECOND SEMESTER

QUANTUM WELL AND NANO STRUCTURED DEVICES

Full marks: 100

Time : Three hours

Use separate answer script for each part.

(All parts of the same question must be answered together)

Part I (Marks: 70)

Answer Q.1 and any FOUR from the rest.

1. Write note on any ONE of the following: 10
 - (a) Superlattice,
 - (b) SEED as an optical switch,
 - (c) Single Electron Transistor.

- 2.(a) Describe the features of various possible hetero-interfaces. Give one example of each category. 9
 - (b) Describe the approximation useful in deriving the energy band structure of random alloys. 6

3. Write down the general form of the DOS function for bulk semiconductor (no derivation). Derive and sketch the same for a semiconductor QWW as a function of energy. Also calculate the electron concentration in the conduction band of the wire. 1+6+2+6

4. Make appropriate approximations and describe the scheme of Transfer Matrix Method to determine : 10+5
 - a) Electron bound state energies in a double quantum well system of unequal widths,
 - b) The coefficient of transmission for an electron thro' a double barrier system separated by a QW.

- 5.(a) Describe the Poisson's effect in the context of pseudomorphic growth of semiconductor heterostructure. Also define Poisson's ratio. 5+2
- (b) Explain how the valence band degeneracy can be restored in a QW under appropriate strain. Also explain the influence of opposite strain on the valence band structure of the above QW. 4+4
- 6.(a) How can you form Q1D electron gas in a bulk semiconductor? Determine the DOS function for electrons in such case. 4+5
- (b) What is *Magneto-size quantization*? Determine the capacity of a Landau level in presence of such quantization. 3+3
- 7.(a) Explain the phenomenon of *Resonant tunneling* and the *I-V* characteristics of a diode that works on the basis of it. 10
- (b) What are the principal advantages of a Resonant tunneling transistor (RTT) over a Resonant tunneling diode (RTD)? Mention the three possible structural configurations of RTT. 2+3

M.E. ELECTRONICS AND TELE-COMMUNICATION ENGINEERING
FIRST YEAR SECOND SEMESTER EXAM, 2019

Quantum Well & nano Structured Devices (ED)

Time: Three hours

Full Marks: 100

PART II

Answer any two [2×15=30]

1. With the help of schematic explain that HBT can be used at RF frequency range. Why is the measured value of β (CE mode current gain) much less than the calculated value? How can measured value be improved? [10+3+2]
2. Derive the expression for drain current and cut-off frequency of MESFET. What are the advantages of HEMT over MESFET? Explain the significance of the alternative name of HEMT as MODFET. [10+3+2]
3. Explain the drawing of Energy band diagram with the help two examples using electron affinity rule (use scale). What is the drawback of such drawing of energy band diagram? Briefly explain one alternative. [10+2+3]