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Roll No. | | | | | | | | | | | | | Total No. of Pages : 02

Total No. of Questions : 08

M.Tech (ECE)(Wireless Communication) (Sem.–3)

SEMICONDUCTOR MILLIMETER WAVE DEVICES

Subject Code : ECE-305

Paper ID : [74639]

Time : 3 Hrs. Max. Marks : 100

INSTRUCTIONS TO CANDIDATES :

1. **Attempt any FIVE questions out of EIGHT question.**
2. **Each question carries TWENTY marks.**

Q1. Briefly explain the operation of microwave transistors giving an emphasis on their performance parameters. Discuss in detail power frequency, current frequency and power gain frequency limitations with respect to a microwave transistor.

Q2. a) Derive an expression for field, potential and capacitance on junction using Depiction layer model of PN junction diode

b) Consider a silicon pn step junction with $N_A = 1\times10^{18}$ cm^{-3} and $N_D = 1\times10^{17}$cm^3, maintained at T= 300K.

i. Calculate the built-in potential (V_{bi}), the depletion layer width (W), and maximum electric field (E(0)) for zero bias (*i.e*, under thermal equilibrium conditions).

ii. Sketch the energy band diagram, charge density distribution, electric field distribution, and potential distribution as a function of position x for both zero bias and 1V reverse bias. Indicate how the values for V_{bi}, W, and E(0) change with reverse bias.

Q3. a) Describe the operating principle and working of Tunnel diode and PIN diode.

b) What is transferred electron effect? In which type of material it is present? How the Domain formation is taking place in Gunn devices and what are its various modes of operation?

Q4. a) Draw the band diagram of GaAs and explain the Gunn effect, whereby negative resistance and therefore oscillations are obtainable under certain conditions from bulk gallium arsenide.

b) Draw J vs E plot for voltage controlled and current controlled mode of Gunn diode in RWH theory. Mention the conditions for Gunn diode to exhibit negative resistance region using Two valley theory.

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Q5. a) Draw the schematic diagram of an IMPATT diode and fully explain the two effects that combine to produce a 180° phase difference between the applied voltage and the resulting current pulse. Give one biggest disadvantage of IMPATT diode oscillator.

b) An IMPATT diode has a drift length of 2 μ m. Determine :

i) The drift time of the carriers.

ii) The operating frequency of the IMPATT diode.

Q6. a) Draw the small signal equivalent circuit of MESFET and describe all the symbols used in the circuit.

b) Explain the working of HEMT and also draw its equivalent circuit.

Q7. a) Using energy band diagram explain the Schottky barrier theory.

b) Draw the energy band diagrams for Schottky diode (with n-type semiconductor) under thermal equilibrium, forward and reverse bias. Also explain and express the small signal approximation of current in Schottky diodes.

Q8. Write short notes on the following :

a) Micromachining techniques for MEMS Switches.

b) Design consideration for millimeter wave oscillators.

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