**Lecture plan**

**EC 5201: Semiconductor Device Physics**

1. **Course Outline of M.Tech. ( Microelectronics and VLSI)**

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| **Sub: Semiconductor device physics** | **Sub Code: EC 5201** | **Course Coordinator: Dr.B.Bhowmick** |
| Dr. B.Bhowmick | **Sem : MTech Ist sem** | **Academic Session: July-Dec’2021** |

**Course Description:**

The course has been designed with the objective of providing the students a detailed and advanced knowledge of Semiconductor devices with a special emphasis in respect of its application in VLSI domain. The course discusses in detail the principles of working of each of the device, makes the students enable to carry out detailed analysis of device, and fulfills the need of the students in pursuing higher study in the related field or to start their career as practicing engineer and a researcher.

**Course Content**

Introduction to semiconductor physics: review of crystal structure and harmonic wave motion, evolution of quantum mechanics, Schrodinger’s wave theory, bound and scattering states, quantum tunneling, one electron theory – Bloch theorem, Kronig-Penney model, crystal momentum and effective mass, 3D lattice diagram, allowed and forbidden bands, density of states, carrier statistics and distribution−– E k functions, generation and recombination - excess carriers in semiconductors, Boltzmann transport 3 equation, Continuity equation, Poisson’s equation and their solution; High field effects: velocity saturation, hot carriers and avalanche breakdown. Semiconductor junctions: Schottky and Ohmic contacts, homo- and hetero-junction band diagrams and IV characteristics, small signal switching models.

**Texts/References:**

1. D. J. Griffiths , Introduction to Quantum Mechanics

2. D. A. Neamen, Semiconductor Physics and Devices

3. R. L. Liboff, Introductory Quantum mechanics

4. N. W. Ashcroft and N. D. Mermin, Solid State Physics

5. J. P. Mckelvey, Solid State and Semiconductor Physics, Harper and Row, 1966.

6. D.K. Schroder, Semiconductor Material and Device Characterization, John Wiley, 1990.

7. C.T. Sah, Fundamentals of Solid-State Electronic Devices, Allied Publishers and World Scientific, 1991. 8. E.F.Y. Waug, Introduction to Solid-State Electronics, North Holland, 1980

**COs:**

The students will be able to:

CO1. Apply the fundamental principles and applications of modern electronic and semiconductor devices

CO2. Analyze the basic semiconductor device physics and its application to other devices

CO3. Demonstrate quantum mechanics and its applications in semiconductor devices.

CO4. Illustrate band engineering

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| **Lect. Sl no** | **Contents to be covered** | **CO Mapping** |
| 1 | Introduction to semiconductor physics | CO1 |
| 2,3,4 | evolution of quantum mechanics, Schrodinger’s wave theory | CO2, CO3 |
| 5 | review of crystal structure and harmonic wave motion | CO2, CO3 |
| 6,7 | bound and scattering states, quantum tunneling, | CO2, CO3 |
| 8,9,10 | one electron theory – Bloch theorem, Kronig-Penney model | CO2, CO3 |
| 11,12 | crystal momentum and effective mass, 3D lattice diagram | CO2, CO3 |
| 13,14,15 | allowed and forbidden bands, density of states | CO1, CO2 |
| 16,17,18 | carrier statistics and distribution−– E k functions, | CO2, CO3 |
| 19,20,21,22 | generation and recombination - excess carriers in semiconductors | CO1, CO4 |
| 23,24,25,26 | Boltzmann transport equation, Continuity equation | CO2 |
| 27,28 | Poisson’s equation and their solution | CO2 |
| 29,30,31 | High field effects: velocity saturation, hot carriers and avalanche breakdown | CO4, CO2 |
| 32,33 | Semiconductor junctions: Schottky and Ohmic contacts | CO2, CO4 |
| 34,35 | small signal switching models. | CO2 |