**BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, PILANI**
**INSTRUCTION DIVISION**
**FIRST SEMESTER 2013-2014**
**Course Handout (Part II)**

**Date: 02/08/2016**

In addition to part I (General Handout for all courses appended to the time table) this portion gives further specific details regarding course.

**Course No**.            : **MEL G631**
**Course Title**          : **Physics and Modeling of Microelectronic Devices**
**Instructor-in-charge**  : **NILADRI SARKAR**

**1. Scope and objective of the course:** This course aims at making the basic physical concepts behind microelectronic devices clear and imparts modeling information about these devices for their use as circuit elements in integrated circuits.

**2. Text Book:** Muller R. S and Kamins T. I., "Device Electronics for Integrated circuits", John Wiley, 3rd ed., 2003.

  **Reference Books:**
  (i)  Sze S. M., "Physics of Semiconductor Devices", 2nd Ed.,  Wiley Eastern, 1981.
  (ii) Tyagi M. S., " Introduction to Semiconductor Materials and Devices", John
      Wiley & Sons, 1991.

**3. Course Plan:**

| Lecture Number | Learning Objectives | Topics to be Covered | References (Chap/Sec) (Text Book) |
|---|---|---|---|
| **1-2** | Fundamental of semiconductors; Band and Bond Models | Semiconductor Materials | 1.1 |
| **3-5** | Concepts of Holes, Mobility Drift, Diffusion, etc. | Free Carriers and Hall Effect Measurements | 1.2 & 1.3 |
| **6** | Meaning of Equilibrium in Electronic System | Metal-Semiconductor Contact. | 3.1 |
| **7-8** | Ideal M-S Contact Without & With Bias and Variation of Charge, Potential, Field, etc. | M-S Junctions | 3.2 |
| **9** | Schottky Contacts | M-S Contact | 3.3 & 3.4 |
| **10** | Surface States & Effects | Surface Effects | 3.5 |
| **11-13** | Effects of Impurity Distribution and Types of p-n junction and their properties. | pn junction | 4.1 & 4.2 |
| **14** | Effect of Bias and Junction Breakdown. | pn junction under bias | 4.3 & 4.4 |

| 15-16 | JFET, its working and analysis | JFET | 4.5 |
|---|---|---|---|
| 17-19 | Continuity Equation, Generation & Recombination, Localized States | Currents in pn junction | 5.1 & 5.2 |
| 20-21 | Ideal- Diode Analysis and Validity of Approximations in the same. | Current-Voltage Characteristics | 5.3 |
| 22-23 | Transistor action, Various bias conditions and use in IC. | Bipolar transistor | 6.1 |
| 24-26 | npn transistor under active bias, its function, parameters | Transistor under active bias | 6.2 |
| 27 | Transistor switching and different regions of operation | Transistor switching | 6.3 |
| 28-30 | MOS structure, energy band diagrams in equilibrium/ under bias conditions | MOS system | 8.1 & 8.2 |
| 31-32 | Equilibrium and non-equilibrium analysis in MOS electronics | MOS Electronics | 8.3 |
| 33 | Capacitance of MOS system and its variation | MOS Capacitance | 8.4 |
| 34 | Effect of oxide and interface charges on MOS system | Oxide charges in MOS | 8.5 |
| 35 | Basic MOSFET Behavior | MOSFET-Physical Effects | 9.1 |
| 36-37 | Improved models for short channel MOSFETs | Short channel MOSFET | 9.2 |
| 38 | Various parameters of MOSFET | MOSFET | 9.3 & 9.4 |
| 39-40 | High Field Effects in MOSFETs | MOSFET-Physical Effects | 10.1 to 10.4 |

## 4. Evaluation Scheme:

| EC No. | Evaluation Component | Duration | Weightage (%) | Date & Time | Nature of Component |
|---|---|---|---|---|---|
| 1. | Assignments, Matlab based Projects and Computer Simulations, Seminars & Quizzes. | | 35% | | |
| 2. | Mid-Term Test | 90 mins. | 30% | 4/10  8:00 - 9:30 AM | Closed/Open Book |
| 3. | Comprehensive Examination | 3 hrs. | 35% | 4/10  8:00 - 9:30 AM | Closed/Open Book |

**5. Chamber Consultation Hour:** To be announced in class.

**6. Notices:** Notices for the course will be displayed on the Notice Board of EEE Group

**7. Make-up Policy:** Make-up will be allowed for genuine cases. Prior application should be sent for seeking the same.

**Instructor-in-charge**

**MEL G631**