

**BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, PILANI**  
**INSTRUCTION DIVISION**  
**FIRST SEMESTER 2015-2016**  
**Course Handout (Part II)**

**Date: 03/08/2015**

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, 3<sup>rd</sup> ed., 2003.

**Reference Books:**

- (i) Sze S. M., “Physics of Semiconductor Devices”, 2<sup>nd</sup> Ed., Wiley Eastern, 1981.
- (ii) Tyagi M. S., “ Introduction to Semiconductor Materials and Devices”, John Wiley & Sons, 1991.

**3. Course Plan:**

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

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

#### 4. Evaluation Scheme:

<b>EC No.</b>	<b>Evaluation Component</b>	<b>Durati on</b>	<b>Weight age (%)</b>	<b>Date &amp; Time</b>	<b>Nature of Component</b>
1.	Assignments, Matlab based Projects and Computer Simulations, Seminars & Quizzes.		35%		
2.	Mid-Term Test	90 mins.	30%	8/10 10:00 - 11:30 AM	Closed/Open Book
3.	Comprehensive Examination	3 hrs.	35%	8/12 AN	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**