

**University of Management and Technology**

**School of Science and Technology**

***Department of Physics***

**Course Code: PH 315**

**Course Title: Semiconductor Devices**

**Program: BS (Physics)**

**Course Outline (Fall 2022)**

**Learning outcome**

After successful completion of this course students will be able to understand the motion of carriers in semiconductor materials and they also will be able to illustrate the operational principles of common electronic devices including PN junction diode, Schottky diode, Photo diodes, Solar cells, LED and Bipolar junction transistor.

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| **Schedule** | Wednesday: 11:00-12:15  Friday: 9:30-10:45 | **Counseling Hours** | Wednesday: 2:00-4:00  Friday: 2:00-4:00 | |
| **Course Coordinator** | Dr. Muhammad Imran | **Contact** | muhammad\_imran@umt.edu.pk | |
| **Office** | 3S-38 (2nd floor, Main Building UMT) | | | |
| **Text**  **Book** | “Semiconductor Physics and Devices Basic Principles” by Donald A. Neamen,4th edition 2011. | | | |
| **Reference Books:** | “Semiconductor Devices: Theory and Application” by James M. Fiore, August 2019.  “Introduction to Semiconductor Materials and Devices” by M.S. Tyagi, 2004 | | | |
| **Assignments** | Problems will be assigned at regular intervals as an assignment. | **Quizzes** | | All quizzes will be announced before time.  No make-ups will be offered for missed quizzes. |
| **Mid Term**  **Examination** | A 75-minutes exam will cover all the material covered during the first 14-16 lectures. | **Final**  **Examination** | | A 120-minutes exam will cover all the material covered during the semester. |
| **Attendance**  **Policy** | Students missing more than 25% of the lectures will receive an “SA” grade in the course and will not be allowed to take Final exam. | | | |
| **Grading**  **Policy** | Assignment+ Quizzes+ Presentation+ Class Participation etc.: 30%  Mid Term Examination: 30%  Final Examination: 40% | | | |

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**Lecture Plan**

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| **Week** | **Lec**  **#** | **TOPICS** | **Chap#** |
| 1 | 1  2 | Semiconductor Materials, Types of solids, Space lattice  Atomic Bonding, Imperfections and Impurities in Solids | 1  1 |
| 2 | 1  2 | Principles of quantum mechanics  Schrodinger’s Wave equations | 2  2 |
| 3 | 1  2 | Formation of energy bands  Electrical conduction in Solids | 3  3 |
| 4 | 1  2 | Electrical conduction in Solids  Density of States Function, The Fermi-Dirac Probability Function | 3  3 |
| 5 | 1  2 | Charge Carriers in semiconductor  Dopant atoms and energy levels, The extrinsic Semiconductors | 4  4 |
| 6 | 1  2 | Statistics of Donors and Accepters  Charge Neutrality, Position of Fermi levels | 4  4 |
| 7 | 1  2 | Carrier Drift and Carrier Diffusion  The Hall Effect | 5  5 |
| 8 | 1  2 | Carrier Generation and Recombination  Characteristics of Excess Carriers | 6  6 |
| 9 | 1  2 | Transport equation  Quasi-Fermi levels | 6  6 |
| 10 | 1  2 | Basic Structure of pn Junction  Reverse Applied bias pn junction | 7  7 |
| 11 | 1  2 | Forward bais pn junction  Generation and recombination currents | 8  8 |
| 12 | 1  2 | The Schottky Barrier Diode  Metal-Semiconductor Ohmic contacts | 9  9 |
| 13 | 1  2 | The bipolar transistor Action  Minority Carrier Distribution | 10  10 |
| 14 | 1  2 | The Junction Field-Effect Transistor  The Junction Field-Effect Transistor | 13  13 |
| 15 | 1  2 | Optical absorption, Solar Cell  Photodetectors and Light emitting diode. | 14  14 |

**The best gift from a father to his child is education and upbringing**.