



# Curriculum & Syllabus

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| Course Name                                                                        | Solid State Electronic Devices                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Course Code       | EC2000    |   |   |   |
| Offered by Department                                                              | Electronics & Communication Engineering                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Structure(L TP C) | 3         | 1 | 0 | 4 |
| Offered for                                                                        | B.Tech                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Course Type       | Core      |   |   |   |
| Prerequisite                                                                       | NIL                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Approved In       | Senate-44 |   |   |   |
| Learning Objectives                                                                | The course is an introduction to semiconductor fundamentals and applications to the electronic devices. Students will understand the internal workings of the most basic solid state electronic devices. Course creates the background in semiconductor-based electronic devices and also prepares students for advanced courses in nano- and quantum electronics.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                   |           |   |   |   |
| Learning Outcomes                                                                  | At the end of the course, the students would be able to <ul style="list-style-type: none"><li>• Understand and explain the fundamental principles of modern semiconductor devices.</li><li>• Understand and describe the impact of semiconductor device capabilities and limitations on electronic circuit performance.</li><li>• Develop semiconductor devices based sensors.</li><li>• Design FET based circuits and devices.</li></ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                   |           |   |   |   |
| Course Contents (with approximate breakup of hours for lecture/ tutorial/practice) | <ul style="list-style-type: none"><li>• <b>Solid state devices</b> – History and its relevance in the modern world. formation of energy bands in semiconductors, Density of states and Fermi level. (L3+T1) • <b>Charge carriers in Semiconductors</b>- Equilibrium Carrier concentration, Recombination and Generation of carriers, Carrier transport – Drift, Diffusion and their modelling in MATLAB. (L9+T2)</li><li>• <b>pn junction</b> – derivation of dc and ac characteristics, Forward and reverse biasing, Static analysis, Breakdown processes; Transient analysis, metal semiconductor junction. Modelling of p-n junction. (L9+T3)</li><li>• <b>Bipolar junction transistors</b>– Fundamentals and characteristics, biasing, switching, Modelling of BJT. (L4+T1)</li><li>• <b>Field Effect Transistors (JEFT, MESFET, MOSFET, HEMT), MOS capacitor, MOSFET</b> – device physics, operation, characteristics and modelling. (L10+T3) • <b>Optoelectronic Devices</b>- Fundamentals of Photodiodes, Light emitting devices, Semiconductor LASERs, Solar cells, CCDs along with Nanoelectronic devices. (L6+T1)</li></ul> |                   |           |   |   |   |
| Essential Reading                                                                  | 1. Robert Pierret, Semiconductor Device Fundamentals ,1 <sup>st</sup> Edition, Pearson Education, ISBN:9788177589771, 2006.<br>2. B. G. Streetman and S. K. Banerjee, Solid State Electronic Devices, 7 <sup>th</sup> Edition, Pearson, ISBN: 9780133356038, 2015.<br>3. Neamen, Donald A., Semiconductor Physics and Devices: Basic Principles, 4th                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                   |           |   |   |   |

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|                       | Edition, NY: McGraw-Hill, ISBN:978-0-07-352958-5, 2012.                                                                                                                                                                                                                                                                              |
| Supplementary Reading | <ol style="list-style-type: none"> <li>1. S. M. Sze., K. K. Ng, Physics of Semiconductor Devices, 3<sup>rd</sup> Edition, United Kingdom, Wiley, ISBN: 978-0471143239, 2021.</li> <li>2. M. S. Tyagi, Introduction to Semiconductor Materials and Devices, 1<sup>st</sup> Edition, John Wiley, ISBN: 9788126518678, 2008.</li> </ol> |