University of Tehran
School of Electrical and Computer Engineering

Course:	**Simulation of Semiconductor Devices**		
Course type:	Elective	EE	Credit: 3
Level:	Graduate		
Co-requisite(s):			
Prerequisite(s):	Physics of Electronics		
Prerequisite by topic:	Physics of semiconductor devices, Numerical methods in solving differential equations, Skills in computer programming		
Textbook(s):	[1] D.Vasileska, S. M. Goodnick, and G. Klimeck, *Computational Electronics: Semiclassical and Quantum Device Modeling and Simulation,* CRC press (2010). [2] K.M. Kramer and W.N.G. Hitchon, *Semiconductor Devices: A Simulation Approach*, Prentice Hall (1997). [3] S. Selberherr, *Analysis and Simulation of Semiconductor Devices*, Springer (1984). [4] R.W. Dutton, Y. Zhiping, *Technology CAD - Computer Simulation of IC processes and Devices*, Springer (1993).		
Coordinator:	Mahdi Pourfath		
Goals:	Introducing the students with the following topics: 1- Hierarchy of semiclassical transport models and understanding the limitation of various models 2- Modeling semiconductor devices 3- Important physical parameters for modeling semiconductor devices 4- Numerical techniques for analyzing semiconductor devices.		
Outcome:	Upon successful completion of the course, students will be able to 1. Obtain a deeper understanding of device physics and its dependence on various parameters 2. Choose proper physical parameters and models for specific application 3. Perform simulations to obtain steady state, transient, and AC response of semiconductor devices and analyze the respective results 4. Extract circuit parameters from semiconductor device simulations		
Topics:	**Semiconductor Equations** Continuity equations, drift-diffusion-model, carrier transport, equilibrium case, boundary conditions		

	Basics of Numerical Analysis Finite differences, numerical solution of differential equations, accuracy of different discretization schemes, solution of linear systems of equations, nonlinear systems of equations **Tessellation of Unstructured Meshes** Two-dimensional Laplace equation, box integration method, Voronoi tessellation, triangular Delaunay meshes, mesh refinement **Transport Phenomena and their Numerical Analysis** Discretization in the time domain, stability of discretization schemes, diffusive problems, convective problems, diffusive and convective problems, Scharfetter-Gummel discretization, **Parameter Modeling** Carrier mobilities, lattice scattering, ionized impurity scattering, surface/interface scattering, carrier heating, carrier generation and recombination, phonon assisted recombination and generation, photon transition, auger generation-recombination, impact ionization, **Advanced Transport Models** Band theory, density of states, equilibrium statistics, non-equilibrium statistics, Boltzmann transport equation, moments of the distribution function, Energy transport model, Monte-Carlo method
Grading:	Assignments: 5% Projects: 15% Midterm exam: 40% Final exam: 40%
Further readings:	
Prepared by:	Mahdi Pourfath
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