Course name	**ECE 30500 Semiconductor Devices**
Credit and contact hours	(3 cr.) Class 3
Course coordinator's name	Peter Schubert
Textbook	Robert F. Pierret, *Semiconductor Device Fundamentals,* Prentice Hall, 1996. ISBN:9780201543933
Course information	ECE 30500 Semiconductor Devices (3 cr.) P: ECE 25500, MATH 26600, and PHYS 25100. Class 3. Materials- and phenomena-based examination of devices, emphasizing the how and why of solid-state device operation. **Prerequisites/ Co-Requisite** P: ECE 25500, MATH 26200, PHYS 25100 **Required, Elective, or Selected Elective:** EE Elective, CE Elective
Goals for the course	Upon successful completion of the course, students should be able to 1. Solve problems of atom spacing for simple, bcc, fcc, and diamond structures. [1] 2. Determine the carrier distribution from the density of states and the Fermi function. [1] 3. Calculate minority and majority carriers from charge neutralization relationship and np product relationship. [1] 4. Describe the various carrier actions including diffusion, drift, recombination and generation. [1] 5. Model the semiconductor materials in energy band diagram and find physical meanings of potential difference and energy on the diagram. [1, 6] 6. Describe the various IC processes required for fabricating a device on a silicon wafer. [2] 7. Determine the electrostatic, dynamic, and transient performances of a PN junction. [1] 8. Construct the I-V characteristics of a P-N junction diode using diffusion and R-G center current components. [1] 9. Design a p-n junction for a given reverse saturation current. [2] 10. Determine the effect of high current, high frequency of the PN junction diode characteristics and parameters. [1] 11. Design photodiodes for high frequency operation using PiN, and compare between Avalanche Photodiodes with PiN in terms of S/N ratio. [1] 12. Determine the conditions on forming compound semiconductors of compound substrate materials that are suitable for LEDs. [1]

	13. Determine the electrostatic, dynamic, and transient performances of a PNP/NPN BJTs. [1] 14. Describe the physics behind base width modulation and punch-through. [1] 15. Determine the effect of dc collector current on dc current gain of a BJT. [1] 16. Explain and apply theories of the PNPN device characteristics and means of their firing using SCS and UJT devices. [1, 6] 17. Apply MS Schottky diodes to BJT for high speed operation to design of MOSFET. [1,6] 18. Determine the dc and ac characteristics for JFET and MOSFET. [1] 19. Obtain a general expression for the threshold voltage of a MOSFET device including ion implantation and body effect. [1]
List of topics to be covered	1. Semiconductor materials and models (2 classes) 2. Carrier properties and statistics (3 classes) 3. Carrier action: drift, diffusion and recombination-generation (5 classes) 4. PN junction fabrication; electrostatics (3 classes) 5. Ideal diode I-V characteristics (1 class) 6. Derivation of ideal diode equation (3 classes) 7. Deviations from ideal behavior: avalanche, Zener and tunnel diodes (1 class) 8. Bipolar junction transistors (6 classes) 9. Field effect transistors (2 classes) 10. MOS structure, electrostatics (2 classes) 11. MOSFET devices (2 classes)
Syllabi approved by	Maher Rizkalla
Date of approval	04/10/2021