School of Engineering and Computer Science

ECE 327: Introduction to Power Electronics
Master Syllabus

Catalog Data:	**ECE 327: Introduction to Power Electronics**; 3 credits (2-3) Power semiconductors, high-frequency magnetics, and their application to switch-mode power converters, electric motor drives, and utility systems. Typically offered in Spring.
Class Schedule:	Two lecture hours per week, for one semester.
Laboratory Schedule:	One 3-hour lab session, for one semester.
Prerequisites by Course:	ECE 321 and ECE 325
Prerequisites by Topic:	1. Knowledge of the principals and applications of electronic devices including semiconductor diodes, bipolar-junction and field-effect transistors. 2. Understanding of transformers and magnetically coupled circuits. 3. Can use Laplace transforms to analyze circuits.
Typical Text:	Mohan, N., *Power Electronics: A First Course*, Wiley 2012
Course Coordinator:	Dr. Hang Gao
Course Objectives:	Students will: 1. Describe the role of Power Electronics as an enabling technology in various applications such as flexible production systems, energy conservation, renewable energy, transportation, etc. 2. Learn the basic concepts of operation of dc-dc converters in steady state in continuous and discontinuous modes and be able to analyze basic converter topologies. 3. Using the average model of the building block, quickly simulate the dynamic performance of dc-dc converters and compare them with their switching counterparts. 4. Design controllers for dc-dc converters in voltage and peak-current mode. 5. Design, using simulations, the interface between the power electronics equipment and single-phase and three-phase utility using diode rectifiers and analyze the total harmonic distortion. 6. Design the single-phase power factor correction (PFC) circuits to draw sinusoidal currents at unity power factor. 7. Learn basic magnetic concepts, analyze transformer-isolated switch-mode power supplies and design high-frequency inductors and transformers. 8. Learn basic concepts of soft-switching and their applications to dc-dc converters, compact fluorescent lamps (CFL) and induction heating. 9. Learn the requirements imposed by electric drives (dc and ac) on converters and synthesize these converters using the building block approach. 10. Understand, simulate and design single-phase and three-phase thyristor converters.

Topics Covered:		1. Design of switching power-poles 2. Switch-mode dc-dc converters 3. Feedback controllers for switch-mode dc power supplies 4. Rectification of utility input using diode rectifiers 5. Power-factor-correction circuits 6. Magnetic circuit concepts 7. Switch-mode dc power supplies 8. Design of high-frequency inductors and transformers 9. Converters for induction heating and compact fluorescent lamps 10. Motor drives, uninterruptible power supplies, and power systems 11. Synthesis of dc and low-frequency sinusoidal ac voltages 12. Thyristor converters 13. Utility applications of power electronics
Lab Experiments and Activities:		Laboratory experiments which complement the topics covered include: 1. Buck converter 2. Switching characteristics of power MOSFET and diode 3. Boost converter 4. Buck-boost converter 5. Voltage-mode control 6. Peak-current-mode control 7. Flyback converter 8. Forward converter
Course Outcomes:	Students will be able to:	
	Assessed for Student Outcomes	1-c. Use appropriate models to formulate solutions related to power converters, electric motor drives, and utility systems. 6-c. Conduct analysis and interpretation of the data in power electronics. 6-d. Draw conclusions by evaluating experimental results with respect to engineering knowledge in power electronics.
	Other	2-b. Apply design process to satisfy project requirements for electrical and/or electronic devices and systems in power electronics such as power semiconductors and high-frequency magnetics.
Relationship of Course to Program:		Meets: Educational Objectives 1, 2, 3, 4 Student Outcomes 1, 2, 5, 6, 7
Prepared by:		Date: Revised 3/27/2018, Rev 12/14/18 JL/FM; Rev. 5.23.19 JL; 8/31/21