The University of Jordan
School of Engineering
Department of Electrical Engineering
1st Semester – A.Y. 2017/2018

Course code:	**0923784**
Course title:	**Advanced Power Electronics**
Course Website:	-
Catalog Data:	Power electronics basics review. Non-isolated converters: Cuk converters. Isolated converter: forward converter, flyback converter, full and half bridge converter. AC/AC controllers: introduction, single and three phase converters, cycloconverters. Matrix converters. Multi-level inverters: concept and types of multilevel inverters: Diode clamped, flying capacitor, and cascaded multi-level inverters. Utility applications: high-voltage DC transmission, flexible AC transmission systems, static VAR compensation, interconnection of renewables to the utility grid.
Prerequisites by Course:	None
Prerequisites By Topic:	Students are assumed to have a background in the following topics: • Advanced circuit analysis techniques. • Advanced electromagnetic concepts.
Textbook:	**Power Electronics: Circuits, Devices and Applications by M. Rashid, 4th edition, Prentice-Hall, 2013.**
References:	• *Power Electronics: Converters, Applications and Design* by N. Mohan, T. Undeland, and W. Robins,3rd edition, John-Wiley, 2002. • *Power Electronics: Daniel W. Hart, Mcgraw-Hill international edition, 2011.* • *Elements of Power Electronics* by P. Krein, 1st edition, Oxford University Press, 1997. • *Power Electronics* by C. W. Lander, 3 sub edition, McGraw-Hill, 1994. • *Principle of Power Electronics* by J. Kassakian, M. Schlecht and G. Verghses, 1st edition, Addison Wesley, 1991. • *Power Electronics: Principles and Applications* by J. Vithayathil,1st edition, McGraw-Hill, 2001.
Schedule & Duration:	16 Weeks, 42 contact hours (50 minutes each) including exams.
Minimum Student Material:	Textbook, class handouts, scientific calculator, and an access to a personal computer.
Minimum College Facilities:	Classroom with whiteboard and projection display facilities, library, and computational facilities with MATLAB and SPICE programs.
Course Objectives:	• This is an advanced course to Power Electronics provided by the department of Electrical Engineering for the Electrical Engineering master students. It is designed to achieve the following objectives: • Highlight the merits & drawbacks of Power Electronics compared to conventional alternatives. • DC-DC converters: Buck, boost,buck/boost, Cuk, Forward, Flyback, and full bridge converters. Configuration circuits and characteristics, design considerations and limitations. • Inverters, Power circuit configurations, control topologies and waveforms constructions. PWM, SPWM switching techniques. Single and three phase inverters. Multilevel inverters. • Introduce the major Power Semiconductor Switches with detailed features and applications.

- Investigate the rectification process under different loading conditions. This includes single-phase & three-phase, half-wave & full-wave, and fully-controlled & half-controlled systems.
- Introduction to the utility applications: HVDC and FACTS.

Course Learning Outcomes and Relation to Program Learning Outcomes:

Upon successful completion of this course, a student should:

1. Understand the role of power electronics in power conditioning systems and applications. [i.ii]
2. Realize the merits and drawbacks of power electronics converters compared to conventional alternatives [i,ii]
3. To master the knowledge of power electronics switches (diodes, power transistors and thyristors). This includes: symbols, ratings, classifications and characteristics. [i,iii]
4. To master the knowledge of inverter circuits and their control topologies. [i.ii]
5. To master the knowledge of AC Voltage regulators, and matrix converter and their control topologies. [i.ii]
6. To master the knowledge of DC Choppers, non-isolated converters and their control topologies. [i.ii]
7. To master the knowledge of AC/DC rectifier and their control topologies. [i,ii]
8. To be familiar with utility applications of power electronics [ii,iii]

Program learning outcomes

i Demonstate a sound, in-depth and up-to-date technical knowledge in the field of specialization.

ii Ability to identify and solve engineering problems in their chosen field of study.

iii Acquir the skills for continued professional development and independent self-study.

iv Demonstrate the ability to communicate technical informatiom effectively and professionally both orally and in writing..

Course Topics:

		Hrs
1.	Power electronics basics review:Switching components: MOSFET, IGBT, GTO, SCR, DIAC, TRIAC.DC/DC converters: buck, boost, and buck/boost converters. Inverters: single and three phase inverters, PWM and SPWM techniques, phase shift and dead band inverters. Rectifiers: uncontrolled half and full wave rectifiers, controlled rectifiers, controlled and uncontrolled three phase rectifiers.	**12**
2.	DC/DC converters: non-isolated converters: Cuk converters. Isolated converters (switched mode DC power supplies): forward converter, flyback converter, full and half bridge converter.	**9**
3.	Rectification Process and Rectifier Circuits**:** power circuit configurations, triggering signals and conduction pattern, principle of operation, waveforms construction, analysis and solution for resistive, inductive and highly-inductive loading conditions, performance evaluation both in load and supply sides.	**6**
4.	AC/AC controllers: introduction to AC/AC controllers, single and three phase converters, cycloconverters: single and three phase cycloconverters. Matrix converters.	**6**
5.	Multi-level inverters: concept and types of multilevel inverters. Diode clamped, flying capacitor, and cascaded multi-level inverters.	**6**
6.	Utility applications: high-voltage DC transmission, flexible AC transmission systems, static VAR compensation, interconnection of renewables to the utility grid.	**3**

Ground Rules: **Attendance is mandatory** and highly encouraged. To that end, attendance will be taken every lecture. All exams (including the final exam) should be considered **cumulative**.

Assessments: Exams, projects, and term papers.

Grading policy:

Projects and term papers	**30 %**
Midterm Exam	**30 %**
Final Exam	**40 %**
Total	**100%**

Last Updated: Mar 27, 2017