EE 547: Advanced Power Electronics

Lecture Schedule	Tuesday and Thursday 16:30 – 18:00	**Course Type, Semester**	Core for Power , Electronics & Communication Fall 2017
Credit Hours	Three	**Pre-requisites**	Undergraduate course in (1) Power Electronics (2) Signals and Systems.
Instructor	Umar T. Shami	**Contact**	utshami@uet.edu.pk
Office	Industrial and Power Electronics Lab, Ground Floor, E. E. Depart., U.E.T.	**Office Hours**	Tuesday and Thursday 16:00pm
Course Description	The course will cover the subject of advanced power electronics in detail; including important topics as generic power converter, comparison of semiconductor power switches, supplementary components and systems, phase-controlled rectifiers, voltage-source inverters, matrix converters, multilevel inverters, soft-switching inverters, isolated and non-isolated switched-mode DC-to-DC converters, power electronics applications to energy conservation.		

Measurable Learning Outcomes	**CLOs**	**Description**	**Taxonomy Level**	**PLOs**	**Level**
	CLO1	Apply the concept of solid state electronics to realize semiconductor general properties and supplementary components for power electronics.	C-2	PLO1	High
	CLO2	Analyze the basic operation of PWM and Phase-controlled Rectifiers.	C-3	PLO2	High
	CLO3	Investigate DC to AC Voltage-Source Inverters including analysis.	C-4	PLO4	High
	CLO4	Evaluate DC to DC converters and renewable energy applications	C-5	PLO7	High

Textbooks	**REQUIRED**: Introduction to Modern Power Electronics By Andrzej M. Trzynadlowski, Wiley 2016. **OPTIONAL**: Optimal design of switching power supply By Zhanyou Sha, Xiaojun Wang, Yanpeng Wang, and Hongtao Ma, Wiley, 2015.
Grading Policy	• Quizzes + Assignments 30% CLO1 and CLO3 • Midterm 30% CLO1 and CLO2 • Final 40% CLO3 and CLO4

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Week	Topics	Recommended Readings & CLOs
1.	**Principles of Electric Power Conversion** Introduction To The Subject, What Is Power Electronics, Generic Power Converter, Waveform Components and Figures of Merit, Phase Control, Pulse Width Modulation.	A.M. Trzynadlowski Chap-1 CLO-1
2.	**Semiconductor Power Switches** General Properties Of Semiconductor Power Switches, Power Diodes, Semicontrolled Switches, Fully Controlled Switches, Comparison Of Semiconductor Power Switches, Power Modules.	A.M. Trzynadlowski Chap-2 CLO-1
3.	**Supplementary Components and Systems** What Are Supplementary Components And Systems?, Drivers.	A.M. Trzynadlowski Chap-3 CLO-3
4.	**Supplementary Components and Systems** Overcurrent Protection Schemes, Snubbers, Filters.	A.M. Trzynadlowski Chap-3 CLO-1
5.	**AC-to-DC Converters** Diode Rectifiers, Phase-Controlled Rectifiers, PWM Rectifiers.	A.M. Trzynadlowski Chap-4 CLO-2
6.	**AC-to-DC Converters** PWM Rectifiers, Device Selection For Rectifiers, Common Applications Of Rectifiers.	A.M. Trzynadlowski Chap-4 CLO-2
7.	**AC-to-AC Converters** AC Voltage Controllers, Cycloconverters.	A.M. Trzynadlowski Chap-5 CLO-3
8.	**Mid-Term Week**	**Quiz-1 & Mid-Term Exam**
9.	**AC-to-AC Converters** Matrix Converters, Device Selection For AC-to-AC Converters, Common Applications Of AC-to-AC Converters.	A.M. Trzynadlowski Chap-5 CLO-3
10.	**DC-to-AC Converters** Voltage-Source Inverters, Current-Source Inverters, Multilevel Inverters	A.M. Trzynadlowski Chap-7 CLO-3
11.	**DC-to-AC Converters** Soft-Switching Inverters, Device Selection For Inverters, Common Applications Of Inverters	A.M. Trzynadlowski Chap-7 CLO-3
12.	**DC-to-DC Converters** Static Dc Switches, Step-Down Choppers, Step-Up Chopper	A.M. Trzynadlowski Chap-6 CLO-4
13.	**DC-to-DC Converters** Current Control In Choppers, Device Selection For Choppers, Common Applications Of Choppers	A.M. Trzynadlowski Chap-6 CLO-4
14.	**Switching Power Supplies** Basic Types Of Switching Power Supplies, Non-isolated Switched-Mode DC-to-DC Converters, Isolated Switched-Mode Dc-To-Dc Converters	A.M. Trzynadlowski Chap-8 CLO-4
15.	**Power Electronics and Clean Energy** Why Is Power Electronics Indispensable In Clean Energy Systems, Solar And Wind Renewable Energy Systems, Fuel Cell Energy Systems, Electric And Hybrid Cars, Power Electronics and Energy Conservation.	A.M. Trzynadlowski Chap-9 CLO-4
16.	Review of Course-Discussion on various topics (Dead Week)	
	Final Term Week	**Quiz-2 & Final Term Exam**

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Week No.	Course Plan	CLO	Comments
1.	1.0 Introduction To The Subject. 1.1: What Is Power Electronics? 1.2: Generic Power Converter 1.3: Waveform Components And Figures Of Merit 1.4: Phase Control 1.5: Pulse Width Modulation 1.6: Calculation Of Current Waveforms	**CLO-1**	Follow Chapter 1 – Principles And Methods Of Electric Power Conversion, of the textbook.
2.	2.1: General Properties Of Semiconductor Power Switches 2.2: Power Diodes 2.3: Semicontrolled Switches 2.4: Fully Controlled Switches 2.5: Comparison Of Semiconductor Power Switches 2.6: Power Modules		Follow Chapter 2 – Semiconductor Power Switches, of the textbook.
3.	3.1: What Are Supplementary Components And Systems? 3.2: Drivers		Follow Chapter 3 – Supplementary Components and Systems, of the textbook.
4.	3.3: Overcurrent Protection Schemes 3.4: Snubbers 3.5: Filters		Follow Chapter 3 – Supplementary Components and Systems, of the textbook.
5.	4.1: Diode Rectifiers 4.2: Phase-Controlled Rectifiers 4.3: Pwm Rectifiers	**CLO-2**	Follow Chapter 4 – AC-to-DC Converters, of the textbook.
6.	4.3: Pwm Rectifiers 4.4: Device Selection For Rectifiers 4.5: Common Applications Of Rectifiers		Follow Chapter 4 – AC-to-DC Converters, of the textbook.
7.	5.1: AC Voltage Controllers 5.2: Cycloconverters	**CLO-3**	Follow Chapter 5 – AC-to-AC Converters, of the textbook.
8.	Mid Of Term Examination		Prepare Chap 1,2,3,4, and 5.
9.	5.3: Matrix Converters 5.4: Device Selection For Ac-To-Ac Converters 5.5: Common Applications Of Ac-To-Ac Converters	**CLO-3**	Follow Chapter 5 – AC-to-AC Converters, of the textbook.
10.	7.1: Voltage-Source Inverters 7.2: Current-Source Inverters 7.3: Multilevel Inverters		Follow Chapter 7 – DC-to-AC Converters, of the textbook.
11.	7.4: Soft-Switching Inverters 7.5: Device Selection For Inverters 7.6: Common Applications Of Inverters		Follow Chapter 7 – DC-to-AC Converters, of the textbook.
12.	6.1: Static Dc Switches 6.2: Step-Down Choppers 6.3: Step-Up Chopper	**CLO-4**	Follow Chapter 6 – DC-to-DC Converters, of the textbook.
13.	6.4: Current Control In Choppers 6.5: Device Selection For Choppers 6.6: Common Applications Of Choppers		Follow Chapter 6 – DC-to-DC Converters, of the textbook.
14.	8.1: Basic Types Of Switching Power Supplies 8.2: Non-isolated Switched-Mode Dc-To-Dc Converters 8.3: Isolated Switched-Mode Dc-To-Dc Converters		Follow Chapter 8 – Switching Power Supplies, of the textbook.
15.	9.1: Why Is Power Electronics Indispensable In Clean Energy Systems 9.2: Solar And Wind Renewable Energy Systems 9.3: Fuel Cell Energy Systems 9.4: Electric And Hybrid Cars 9.5: Power Electronics And Energy Conservation		Follow Chapter 9 – Power Electronics and Clean Energy, of the textbook.
16.	Review of Course-Discussion on various topics		