EE 530: Power Electronic Converters

Lecture Schedule	Tuesday and Thursday 16:30 – 18:00	**Course Type, Semester**	Control & Power, Spring 2018
Credit Hours	Three	**Pre-requisites**	Undergraduate course : Power Electronics
Instructor	Umar T. Shami	**Contact**	ushami@ymail.com, 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

Measurable Learning Outcomes	**CLOs**	**Description**	**Taxonomy Level**	**PLOs**	**Level**
	CLO1	Apply the concepts of electronics to realize semiconductor properties; and magnetic components applications for power electronics.	C-3	PLO1	High
	CLO2	Analyze the operation of drivers; along with behavior, and modeling of PWM DC to DC converters.	C-4	PLO2	High
	CLO3	Assess the working of state of the art DC converters.	C-5	PLO4	High
	CLO4	Evaluate the importance of power factor correction; and converters in power grids.	C-5	PLO7	High

Textbooks

Required:
Power Electronic Converters and Systems: Frontiers and applications, Editor: A. M. Trzynadlowski, IET Power and Energy Series, 2015.

Reference Books:
1. Optimal design of switching power supply by Z. Sha, X. Wang, Y. Wang & H. Ma, Wiley, 2015.
2. Power Electronics Handbook by Muhammad H. Rashid, 2011.
3. Pulse-Width Modulated DC–DC Power Converters by M. K. Kazimierczuk, Wiley, 2016.
4. Renewable Energy Systems - Advanced Conversion Technologies by F. L. Luo & H. Ye, CRC Press, 2012.

Grading Policy

• Quizzes (Three quizzes in total)	30%	CLO1 and CLO3
• Midterm	30%	CLO1 and CLO2
• Final	40%	CLO3 and CLO4

Tentative Lecture Plan EE-530: Power Electronic Converters
Dr Umar T. Shami

Week	Topics	Recommended Readings & CLOs
1.	**Introduction to Power Electronic Converters:** Introduction, High-voltage SiC power devices, Low-voltage SiC devices and its characteristics, Characterization of 1,200 V, 100 A SiC MOSFET, Zero voltage switching characterization of 12 kV SiC, All SiC-based SST.	A.M. Trzynadlowski Chap-1 CLO-1
2.	**Magnetic Components** Magnetic Components-why study, Magnetic circuits-review of important points, Transformers and losses, DC inductor (choke) design, Selection of ferrite core.	Ref. Book: 1 CLO-1
3.	**Magnetic Components** Design of high frequency transformer, Design of Flyback high frequency transformer.	Ref. Book: 1 CLO-1
4.	**Gate Drivers for Power Semiconductor Devices** General Requirements of a Driver, Gate Drivers for SCR / Thyristors, Non-isolated driver for SCR, Isolated driver for SCR using Opto-couplers, Isolated driver for SCR using pulse transformers, Non-isolated driver for MOSFET. (*continued to the next week*)	Ref. Book: 2 CLO-2
5.	**Gate Drivers for Power Semiconductor Devices** Isolated driver for MOSFET using pulse transformers, The Bootstrap technique to driver high-side power switches, Design of discrete Bootstrap circuit to drive high-side connected MOSFETS, Commercial IC based Bootstrap circuit to drive high-side connected MOSFETS.	- do -
6.	**Half-bridge PWM DC–DC Power Converter** Introduction and generic diagram, Half-bridge PWM DC–DC Power converter circuit description, Single-transistor half-bridge converter, Assumptions for circuit analysis, Modes of Operation, DC Analysis of PWM Half-bridge Converter for CCM from $0 \leq t \leq T$.	Ref. Book: 3 CLO-2
7.	**Full-bridge PWM DC–DC Power Converter** Introduction and generic diagram, Full-bridge PWM DC–DC Power Converter Circuit Description, Assumptions for Full-bridge circuit analysis, Modes of Operation of Full-bridge , DC Analysis of PWM Full-bridge Converter for CCM from $0 \leq t \leq T$	- do -
8.	**Mid-Term Examination**	
9.	**Cuk converters** **Fly-Back converters**	Class Notes CLO-3
10.	**Forward converter**	M. K. Kazimierczuk Chap-6 CLO-3
11.	**Multi-input converters** Introduction, Realizing multi-input converter topologies. Recent trends and challenges, scope of further research.	A.M. Trzynadlowski Chap-3 CLO-3
12.	**Multi-input converters** Multi-port converters Theory: Synthesis of multi-port converters by extending multi-input topologies, Multi-port converters with dc link, Ac link multi-port power converters,	- do -
13.	**Multi-input converters** Applications of multi-port power converters: Multi-port power converters for renewable energy systems, Application of multi-input converters in micro-grids, Multi-port converters for vehicular power systems.	- do -
14.	**Power Factor Correction Circuit Design of SMPS** Introduction to Power Factor Correction (PFC), Power Factor and Total Harmonic Distortion, Power Factor Correction Method, PFC Working	Ref. Book: 1 & Ref. Book: 4

	Principle, Design Examples of Passive PFC Circuit, Basic Principle of Active PFC Circuit, Basic Principle of Active PFC Boost Converter.	CLO-4
15.	**Power Factor Correction Circuit Design of SMPS** The Selection of Boost PFC Diode, Design Examples of Active PFC Circuit, Principle and Application of High-Power PFC, Power Factor Correction Circuit Design of SMPS, DC/DC Converterized Rectifiers, PWM Boost-Type Rectifiers	- do -
16.	Review of Course-Discussion on various topics (Dead Week)	
	End of Term Examination	