Lecture # 1

ECEN 438/738 Power Electronics

Spring 2025 Semester

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Texas A&M University
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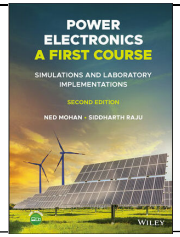
ECEN 438/738 Power Electronics



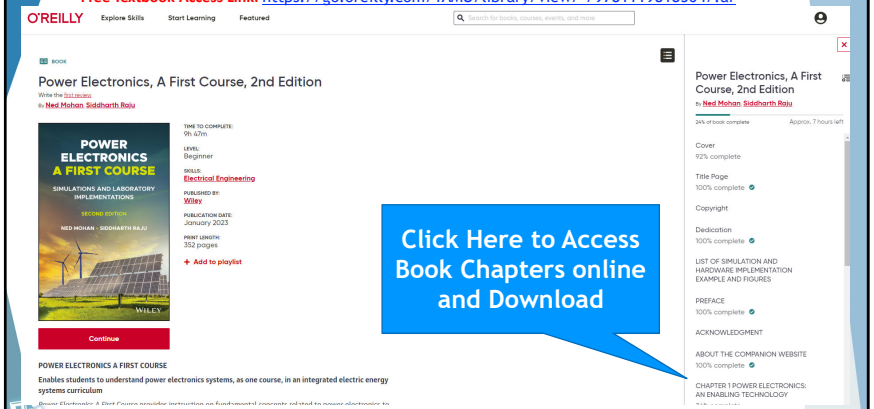
Power Electronics
A First Course: 2nd Edition

Free Textbook Online Access Link: https://go.oreilly.com/TAMU/library/view/-/9781119818564/?ar

Chapter 1
Power Electronics: An Enabling Technology

ECEN 438/738 Power Electronics

Free Textbook Access Link: https://go.oreilly.com/TAMU/library/view/-/9781119818564/?ar



ECEN 438/738 Power Electronics
Quick POLL

- How many of you have taken ECEN 340 – **Electrical Energy Conversion**
- How many have taken 459 / 460
- How many have taken 441 / 442
- How many have taken 420
- NOT TAKEN 325 ?
- HOW MANY ARE TAKING 403/404 – Senior Design ?

ECEN 438/738 Power Electronics

Spring 2025 ECEN 438/738 – Power Electronics - Sections: 501-508; T-TR 8.00 to 9.15 PM; ZACH 241;
Texas A&M University Department of Electrical and Computer Engineering

Class		Sections	Topics
1	Jan 14	**Chapter 1**	Power Electronics – An Enabling Technology, Examples of Energy Conversion % Efficiency
2	Jan 16	**Chapter 2**	Design of Switching Power-Pole, Power Semiconductor devices, selection
3	Jan 21	Section 2.4 to 2.6	Switching characteristics, power loss & design considerations
4	Jan 23	Section 2.4 to 2.6	Example calculations
5	Jan 28	**Chapter 3**	Introduction, Section 3.5 Buck Converter Analysis
6	Jan 30	Section 3.6	Boost Converter Analysis
7	Feb 4	Section 3.7	Design Examples, Buck-Boost Converter Analysis
8	Feb 6	Section 3.11, 3.15	Interleaving, Discontinuous conduction mode
9	Feb 11	Section 3.15	Example Designs
10	Feb 13	**Chapter 5**	AC to DC Diode Rectifiers, Sections 5.1 to 5.3, Example
11	Feb 18	**Exam # 1**	**In Class Chapter 1 to 3**
12	Feb 20	Section 5.4 to 5.6	Diode rectifier analysis, examples
13	Feb 25	**Chapter 6**	Power factor correction circuits, design example
14	Feb 27	**Chapter 7**	Magnetic circuit concepts, Sections 7.1 to 7.4
15	Mar 4	Section 7.5	Transformers, Examples
16	Mar 6	**Chapter 8**	Section 8.4, Flyback Converters
			March 10th to 14th - Spring Break. No classes
17	Mar 18	Section 8.5	Forward Converter
18	Mar 20	Section 8.5	Design Example
19	Mar 25	**Exam # 2**	**In Class Chapter 5 to 8**
20	Mar 27	Section 8.6	Full bridge DC-DC converter
21	Apr 1	Section 8.6	Converter design examples
22	Apr 3	**Chapter 12**	DC to AC Inverters, Sections 12.1 to 12.4
23	Apr 8	Section 12.5	Single Phase Inverters
24	Apr 10	Section 12.5	Pulse width modulation (PWM) Schemes
25	Apr 15	Section 12.6	Three Phase Inverters
26	Apr 17	**Exam # 3**	**In Class Chapter 12** **Last Day to Q-drop is 4/14**
27	Apr 22	Section 12.6	Inverters in UPS Systems and Application to Motor Drives
28	Apr 24	Section 12.7	Multilevel Inverters and Applications
	May 2	**Final Exam**	**1pm to 3pm - Final Exam – See schedule**

Note: Students registered in 738 sections will not write the final exam. Instead, they will work on a semester long project (assigned to them during the week of 3/10) and submit their written final project report due on 5/2.

3 Exams:	40%
Laboratory:	20%
Homework / Quizzes:	20%
Final Exam/Project:	20%
	100%

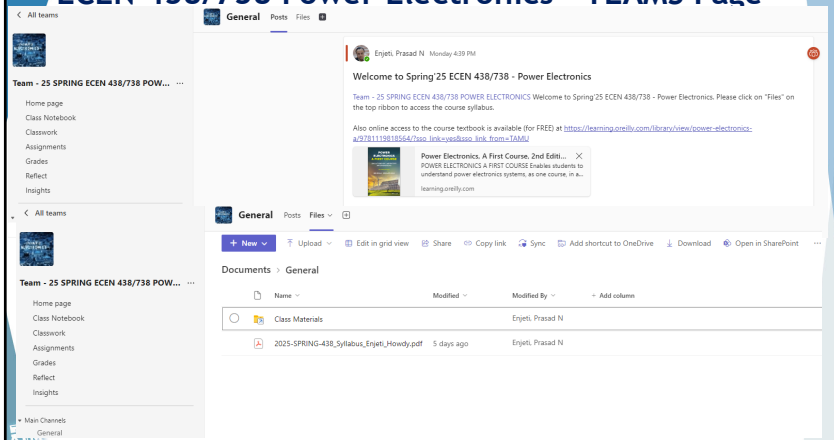
Lab grade is mandatory for passing the course

ECEN 438/738 Power Electronics

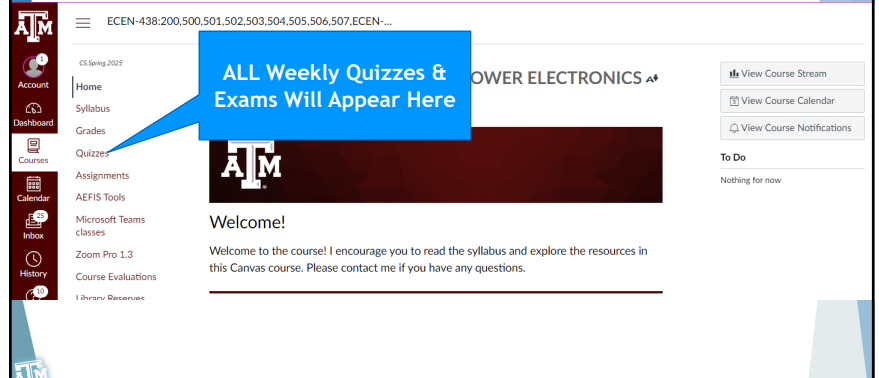
Date:	List of Experiments
Week of January 20th	Lab meeting to discuss, lab format, and simulation software
Week of January 27th	Lab 1 - Linear Regulator in Open Loop DC Operation- **Simulation** / **Experiment** **Pre lab 1 due before session starts**
Week of February 3rd	Lab 2 - Buck Regulator Half-Bridge PWM Operation - **Simulation** / **Experiment** **Pre lab 2 due before session starts** **Lab Report # 1 Due before session starts**
Week of February 10th	Lab 3 - Buck Regulator L-C Filter Operation - **Simulation** / **Experiment** **Pre lab 3 due before session starts** **Lab Report # 2 Due before session starts**
Week of February 17th	Exam # 1 – No Lab
Week of February 24th	Lab 4 - Boost Regulator in CCM Mode Operation – **Simulation** **Pre lab 4 due before session starts** **Lab Report # 3 Due before session starts**
Week of March 3rd	Lab 5 – Error Amplifier Operation– **Simulation** / **Experiment** **Pre lab 5 due before session starts** **Lab Report # 4 Due before session starts**
Week of March 10th	Spring Break – No Lab
Week of March 17th	Lab 6 – Buck Regulator in Closed Loop Operation – **Simulation** / **Experiment** **Pre lab 6 due before session starts** **Lab Report # 5 Due before session starts**
Week of March 24th	Lab 7 AC-DC Rectifier Operation – **Simulation** / **Experiment** **Pre lab 7 due before session starts** **Lab Report # 6 Due before session starts**
Week of March 31st	Exam # 2 – No Lab
Week of April 7th	Lab 8 – Flyback Isolated DC-DC Converter – **Simulation** **Pre lab 8 due before session starts** **Lab Report # 7 Due before session starts**
Week of April 14th	Lab 9 – DC - AC PWM Inverter Operation– – **Simulation** / **Experiment** **Pre lab 9 due before session starts** **Lab Report # 8 Due before session starts**
Week of April 21st	Lab 10 – High-Frequency Transformer Operation – **Simulation** / **Experiment** **Pre lab 10 due before session starts** **Lab Report # 9 Due before session starts**
Week of April 28th	No Lab - **Lab Report # 10 Due**

Lab attendance & grade is mandatory for passing the course

ECEN 438/738 Power Electronics - TEAMS Page



ECEN 438/738 Power Electronics - CANVAS Page



ECEN 438/738 Power Electronics – TEAMS Page

Team - 25 SPRING ECEN 438/738 POWER ELECTRONICS | General | Microsoft Teams

Microsoft TEAMS Access

Prasad Enjeti, Stephen Darwin, Melissa Chou 97 more

25 SPRING ECEN 438 200: HNR-POWER ELECTRONICS

Jan 12, 2025 at 11:23am

Welcome to Spring 2025 - ECEN 438/738 (ALL Sections): You have been added to the TEAMS Page - If you DONT HAVE ACCESS TO the TEAMS Page - Please click on the link below to access the Microsoft TEAMS Page for this Course. ALL course material will be distributed via TEAMS Page.

ALL Students are expected to post questions in the discussion page regarding quizzes / exams etc. Please DO NOT send direct messages (DMs) to me unless you want to discuss your individual situation.

https://teams.microsoft.com/l/channel/19%3AarS-ZuMh9SFaKwnkfI2xkcNdJDIHEq4ekQ6gOmiWAQM1%40thread.tacv2/General?groupId=760805eb-f62e-40b6-b0bc-ba4dcc375ee1

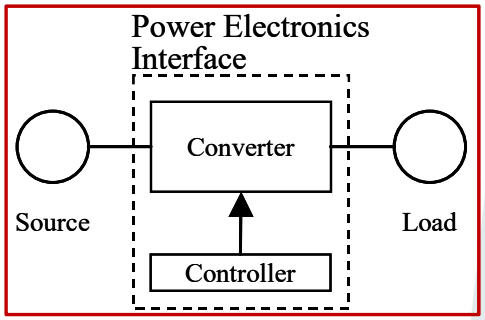
Class Attendance Log: 1/14/25

Howdy!

Introduction to Power Electronics

- Role
- Applications
- Requirements

Role



Applications

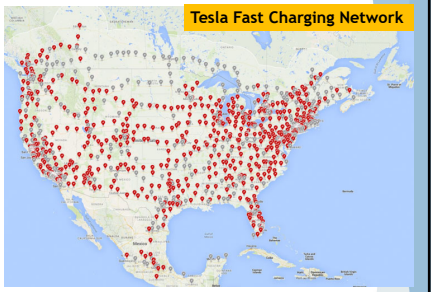
- Portable Electronics
- Consumer Electronics / Appliances
- Renewables-based Electricity Generation
- Electric/Hybrid Vehicles
- Improving Efficiency
- Utility Applications
- Information Technology

Applications – Portable Electronics

Applications – EV – Fast Charging Network

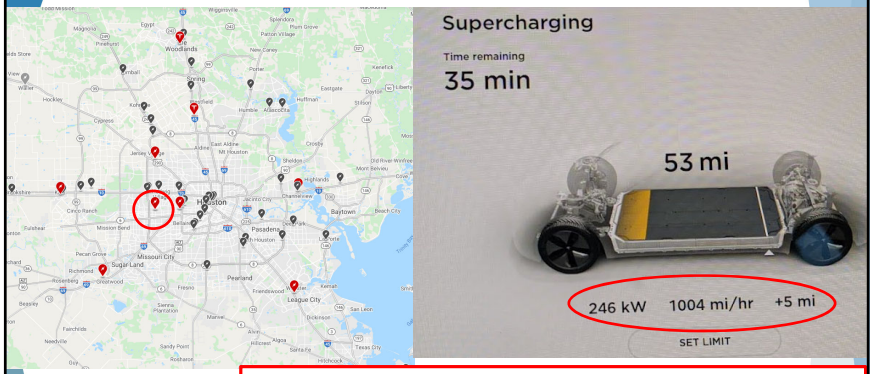
Tesla Fast Charging on the go

Tesla Fast Charging Network



electrify america Is a DC Fast Charging Network. It is a subsidiary of Volkswagen Group of America, established in late 2016 by the automaker as part of its efforts to offset emissions in the wake of the Volkswagen emissions scandal

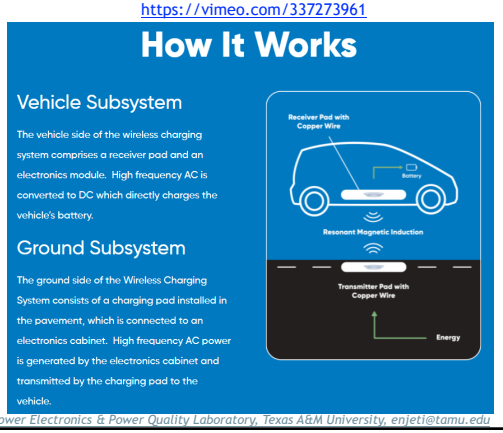
Applications – EV – Fast Charging Network



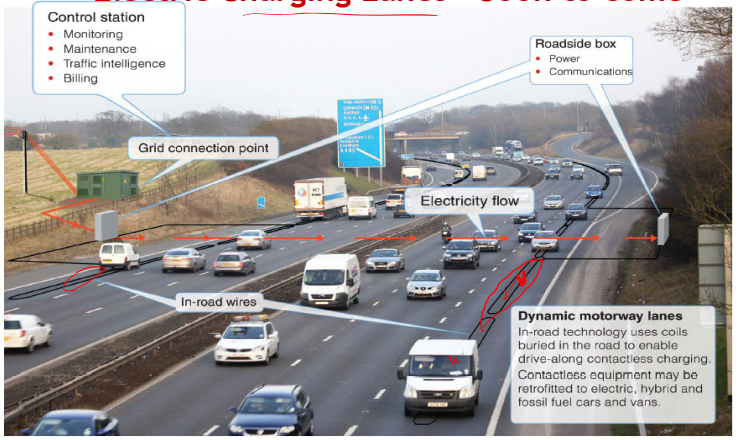
08/14/2021	Houston, TX - 9633 Westheimer Road	Supercharging	$2.76	12 min @ $0.23/min $2.76

EV – Wireless Charging

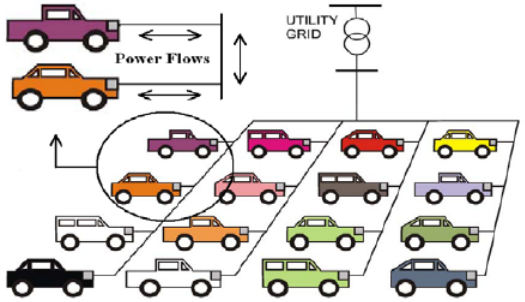
https://vimeo.com/337273961



Electric Charging Lanes – Soon to come



Vehicle to Grid (V2G) – Soon to come



https://www.virta.global/vehicle-to-grid-v2g

Read the Aug 2022 Article

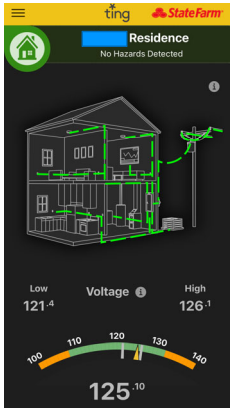
Course Project Topic

Intelligence Smart Home Devices

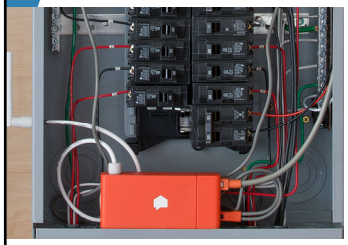
Power grid faults surged right before Los Angeles wildfires began: expert

https://www.yahoo.com/news/power-grid-faults-surged-los-123349045.html

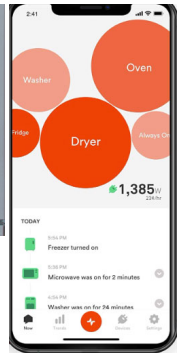
Through a simple, plug-in sensor, Ting enables detection and mitigation of electrical hazards before a fire can start. A single sensor monitors an entire home's electrical system for arcs and sparks, the precursors to imminent fires.



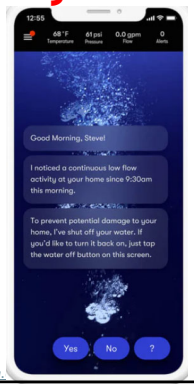
Intelligence Smart Home Devices



Sense.com

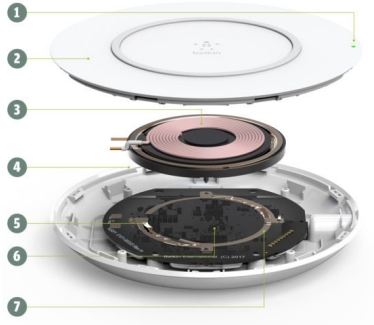


Phyn.com



What's inside a WIRELESS CHARGER

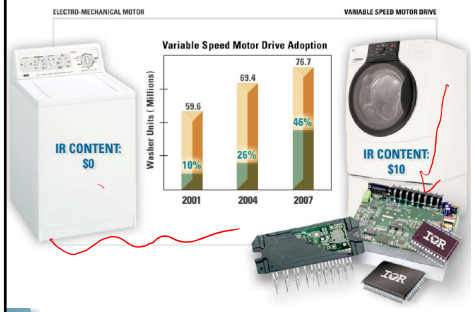
1. LED charging indicator light
2. Non-slip pad surface
3. 7.5W transmitter coil
4. Fanless design for quiet operation
5. Wireless charging chipset controls the flow of electricity
6. Thermal protection sensor can dial back power for safer operation
7. Foreign object detection circuit to prevent conductive materials from receiving power from the charger



SOURCE: BELKIN

Applications: Consumer Electronics / Appliances

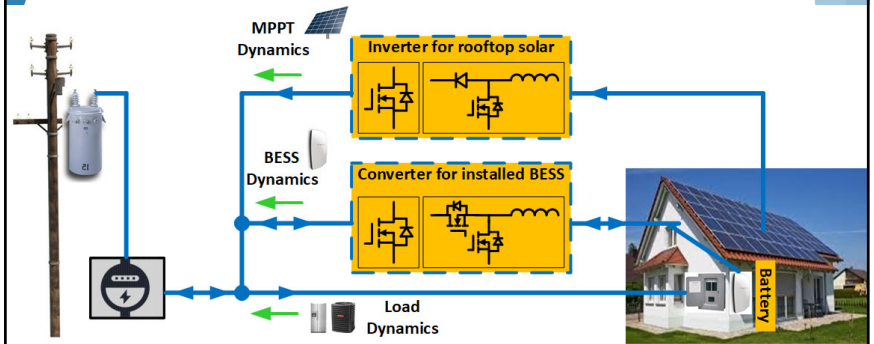
Washer / Dryer / AC Units



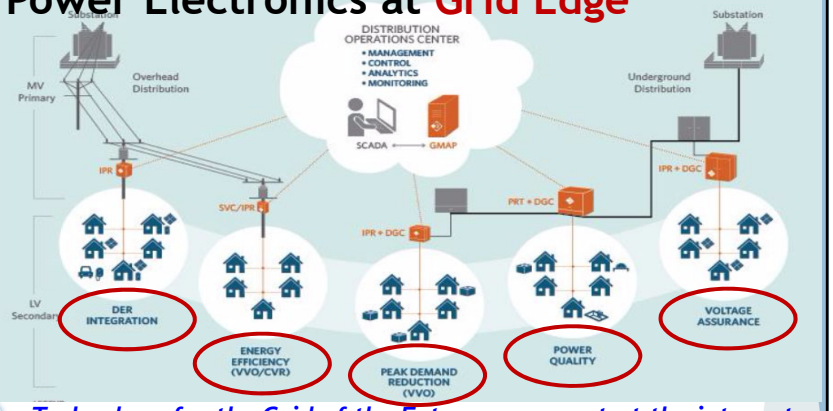
Induction Cooktops

Only the pot gets hot due to high frequency eddy current, while the surface stays cool - safe to touch

Applications: Renewable Energy - Rooftop Solar and Wall Battery



Power Electronics at Grid Edge



Technology for the Grid of the Future - as smart at the internet