



# ELK331E POWER ELECTRONIC CIRCUITS

## Syllabus

Fall 2011, CRN: 11211

*Asst. Prof. Deniz Yildirim*

[www.denizyildirim.org](http://www.denizyildirim.org)

September 19, 2011

## Syllabus Vital Info

- ❖ Instructor : Asst. Prof. Deniz Yildirim
- ❖ e-mail : [deniz@ieee.org](mailto:deniz@ieee.org)
- ❖ www : [www.denizyildirim.org](http://www.denizyildirim.org)
- ❖ Room : 7316
- ❖ Phone : 0212 285 6744
- ❖ TA : Furkan Baskurt
- ❖ Lecture : Three Hours

## Syllabus Course web page

[www.denizyildirim.org/elk331e](http://www.denizyildirim.org/elk331e)

- ❖ All necessary information will be available at the course web page.
- ❖ Your grades can be accessed when available
- ❖ All announcements will be available, hence please check often for last minute changes
- ❖ Course materials and other documents are available in *ITU Ninova* system.
- ❖ [www.ninova.itu.edu.tr](http://www.ninova.itu.edu.tr)

## Course Web Page

[www.denizyildirim.org/elk331e](http://www.denizyildirim.org/elk331e)

**You are responsible to  
check this page  
regarding course vitals.  
NO EXCUSE for NOT  
KNOWING LATER!!!**

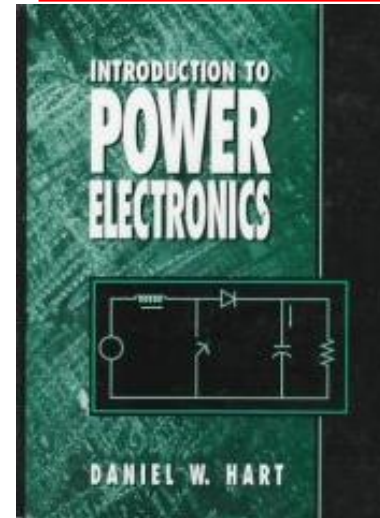
## Your Transcript

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**All students must  
upload their current  
transcript to ITU Ninova  
System  
NO EXCEPTIONS**

## Syllabus, Textbook

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Daniel W. Hart,  
*Introduction to Power  
Electronics*, Prentice  
Hall, 1997.

## Syllabus, Grading

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- ❖ Project 1 - Oct 27, 2011 : 7%
- ❖ Project 2 - Nov 24, 2011 : 8%
- ❖ Project 3 - Dec 15, 2011 : 10%
- ❖ Project 4 - Jan 05, 2012 : 15%
  
- ❖ Midterm Exam I - Nov 03, 2011 : 10%
- ❖ Midterm Exam II - Dec 15, 2011 : 10%
- ❖ Final Exam : 40%

**All exams will be open notes/books**

## Projects

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- ❖ You are going to design, build and test a four basic power electronic circuits for this course,
- ❖ Expect to work in a team,
- ❖ Number of team members cannot exceed **FOUR** students,

## Project Team Policy

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- ❖ You are free to select your fellow group members,
- ❖ If you do not form your team in one week, team members will be assigned randomly by instructor,
- ❖ You have to notify TA about your group members before next class (in one week),
- ❖ Group members cannot change from one project to another.

## Project Groups

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- ❖ Select your group members appropriately, as this may adversely affect overall time that you spent in finishing the Project,
- ❖ All group members must have all the required knowledge about the Project,
- ❖ This will definitely be questioned during the submittal process of your Project,
- ❖ You can use Power Electronics/Electrical Machines Laboratories for building and testing of your supplies.

## Project Reports

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- ❖ Submit a group report for each project assignment (one report per group),
- ❖ Reports must obey the technical report format, if not **ZERO** grade in report,
- ❖ You are also required to submit all assignments electronically in addition to paper submissions through ITU Ninova,
- ❖ Project reports must include title page given in web page – otherwise **ZERO**,
- ❖ Note that **ALL STUDENTS must** upload report – otherwise **ZERO grade in project**

## Report Format and Submission Penalties

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**Project reports that do not include title page receive ZERO GRADE in REPORT!**

**Reports that are not uploaded to ITU Ninova system receive ZERO GRADE in PROJECT!**

## Project Evaluation

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- ❖ Groups will be showing their completed circuits (in Power Electronics Laboratory) on the Due date,
- ❖ Questions will be asked to any group member about the Project to evaluate the level of his/her involvement in project,
- ❖ All group members must be present in this submittal process,
- ❖ Failure to appear will result in a zero grade,
- ❖ Project reports must be handed in to the TA during this process,

## Course Objectives

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Electrical power is widely used in every part of home and industry from milliwatts to megawatts. The main objective of power electronics is to improve the quality and utilization of electrical power. Efficient use of power will, therefore, conserve the energy resources of the world. Power electronics addresses the conversion techniques of electrical energy to achieve these goals.

## Course Content

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- ❖ The answer of "What is Power Electronics?" question and application areas,
- ❖ Semiconductor power switching devices used in power electronic circuits: Diode, BJT, thyristor, triac, diac, GTO, Mosfet, IGBT, IGCT, IEGT. I-V characteristics, operation principles, maximum voltage and current ratings,
- ❖ AC-DC: Alternating Current - Direct Current converters (rectifiers). Single- and three-phase half-wave uncontrolled and controlled rectifiers, multi-pulse rectifiers

## Course Content, cont.

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- ❖ AC-AC: Alternating Current - Alternating Current Converters (AC choppers), Single- and three-phase AC choppers, phase control and burst-firing control methods, Direct frequency converters: Cycloconverters,
- ❖ DC-DC: Direct Current - Direct Current Converters (DC choppers). Buck type class A and boost type class B choppers operating in first quadrant, two- and four-quadrant operation.

## Course Content , cont.

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- ❖ DC-AC: Direct Current - Alternating Current Converters (inverters). Full-wave converters, single- and three- phase square-wave inverters, amplitude and harmonic control, Pulse Width Modulation (PWM) and its principles

## Project 1

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### ❖ *Regulated DC Power Supply: LED Lamp Using Ultra Bright Power LEDs*

- ❖ constant current/voltage
- ❖ output consists of three series-connected ultra bright white power LEDs (each LED power > 1W)
- ❖ input short-circuit protected
- ❖ brightness adjustment - dimmer (bonus)

## Project 1: Special Grading

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- ❖ Project 1 – Oct 27, 2011: 7%

**Bonus: Dimmer Feature**

**additional 40% (10 points)**

## Project 2

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### ❖ *AC Lamp Dimmer*

- ❖ Brightness control of an incandescent lamp
- ❖ Household Outlet Voltage, 220V / 50Hz
- ❖ Lamp power must be larger than 60W
- ❖ Input short-circuit protected
- ❖ Speed control of a single-phase permanent-split capacitor induction motor using same dimmer (bonus point)

## Project 2: Special Grading

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❖ Project 2 – Nov 24, 2011: 8%

**Bonus: Speed Control of Single-Phase Induction Motor**

**additional 50% (12 points)**

## Project 3

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❖ *Speed Control of a Permanent-Magnet DC Motor*

- ❖ Class-A type chopper
- ❖ Single-quadrant operation
- ❖ Unidirectional speed control
- ❖ PWM Control at 50kHz
- ❖ Open- and closed-loop (bonus point) operation for speed regulation

## Project 3: Special Grading

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❖ Project 3 – Dec 15, 2011: 10%

**Bonus: a closed-loop speed control for this project**

**additional 70% (17 points)**

## Project 4

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❖ *Single-Phase Square-Wave and/or Pulse-Width-Modulated (PWM) Inverter*

- ❖ Obtain an AC voltage from a DC source (either 12VDC or 24VDC)
- ❖ Household output voltage - 220V / 50Hz
- ❖ Rated output power of at least 100W, inverter output should light up a 100W bulb (i.e., lamp acts as a resistive load)

## Project 4

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### ❖ *Single-Phase Square-Wave and/or Pulse-Width-Modulated (PWM) Inverter*

- ❖ Square-wave and/or PWM (bonus point) operation
- ❖ Operation with different type of loads - a single-phase permanent-split capacitor induction motor, compact fluorescent lamp (CFL), etc. (bonus point)

## Project 4: Special Grading

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- ❖ Project 4 – Jan 05, 2012: 15%

**Bonus 1: Operation with motor/CFL load**  
**additional 80% (27 points)**

**Bonus 2: PWM Operation**  
**additional 100% (30 points)**

## Project Paths

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- ❖ For each project assignment, a project document will be available at the web page,
- ❖ This document will explain theoretical background and gives necessary information about how to build such a circuit,
- ❖ You can use the procedures outlined in these documents but you are free to use your own methods in achieving the project goals,
- ❖ In this case you have to give detailed background on your method.

## Necessary tools for building miniproject circuits

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## Last Comment

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**You will gain extensive hands-on experience by designing, constructing and testing of four basic power electronic circuits.**

**Improvement of skills at the end of the class**

## Friendly Advice

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**Please note that you will be spending a lot of time in the laboratory.**

**As this may seem frustrating and difficult at the beginning of the course, the knowledge that you will achieve at the end of the semester outweigh this hardship.**

**-- if only you do it the right way and study in a prompt manner.**

## Final Touch

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**DISHONESTY BEHAVIOR OF ANY KIND IN EXAMS OR MINIPROJECT ASSIGNMENTS WILL NOT BE TOLERATED AT ALL.**

**DIRECT COPYING OF SOMEONE ELSE'S WORK (OR LETTING SOMEONE TO DUPLICATE YOUR WORK) AND PRESENTING IT AS YOUR OWN WORK IS CONSIDERED AS ACADEMIC DISHONESTY.**

**FAILURE TO COMPLY WILL RESULT IN A DISCIPLINARY ACTION.**

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*Thank you for  
your attention.  
Questions ?*