

Basic Electrical Engineering

ECS 203

Asst. Prof. Dr. Prapun Suksompong

prapun@siit.tu.ac.th

Introduction to ECS 203



Office Hours:

BKD, 4th floor of Sirindhralai building

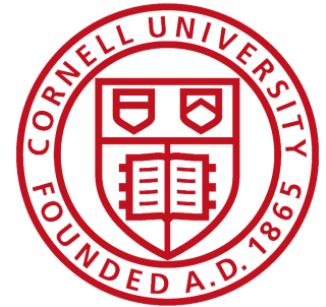
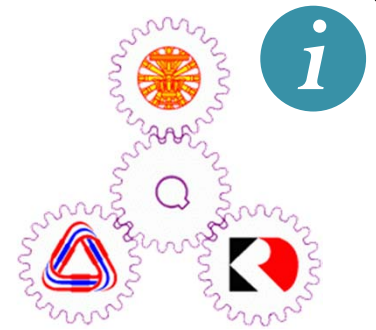
Monday 14:00-16:00

Thursday 10:30-11:30

Friday 14:00-15:00

Me?

- Ph.D. from **Cornell** University, USA
- In Electrical and Computer Engineering
- Minor: Mathematics (Probability Theory)
- Ph.D. Research: Neuro-Information Theory
- Current Research:
Wireless Communications
- 2009 and 2013 SIIT Best Teaching Awards
- 2011 SIIT Research Award
- 2013 TU Outstanding Young Researcher Award



prapun.com



Course Syllabus

(Distributed in class)



Sirindhorn International Institute of Technology
Thammasat University
School of Information, Computer and Communication Technology

ECS 203: Course Syllabus

Semester/Year: 2/2015

Course Title: Basic Electrical Engineering
Instructor: Asst. Prof. Dr.Prapun Suksompong (prapun@siit.tu.ac.th)
Course Website: <http://www2.siit.tu.ac.th/prapun/ecs203/>

Please check the course web site regularly for updated information about this course.

Lectures:

ECS 203 is taught weekly in two lecture sessions of 80 min each. In addition, there will be one-hour weekly tutorial sessions to review prerequisite skills and reinforce concepts learned in lecture through problem solving.

The meeting time and place are arranged according to the following schedule:

Type	Time	Room
Lecture	Tuesday 13:00-14:20	BKD 2401
Lecture	Friday 10:40-12:00	BKD 3507
Tutorial	Monday 11:00-12:00	BKD 2506

You are STRONGLY encouraged to attend lectures. (See the grading policy below.)

Undergraduate Student Dress Code:

- Undergraduate students must wear Thammasat University uniform OR polite dress.
- Plain white shirt, properly tucked in.
- Plain trouser/skirt in dark color.
- The followings are not allowed:
 - Sandals
 - T-shirt (even with the shop shirt)
 - Polo-shirt (even with the shop shirt)

Course Information

Prerequisite: None

Course Description: This course introduces basic electrical engineering principles and technology to students outside the electronics and communication curriculum. Topics include electrical signals, basic circuit theory, DC and AC circuit analysis, Kirchhoff's law, Thevenin/Norton theorems, basic electronic devices and circuits, fundamental of operational amplifiers, fundamentals of power systems, and three-phase circuits.

Textbook: C.K. Alexander and M.N.O. Sadiku, Fundamentals of Electric Circuits, 5th ed., McGraw-Hill, International Edition, 2013. (TK454 A452 2013)

References:

- J. D. Irwin, Basic Engineering Circuit Analysis, John Wiley & Sons, 2002 (TK454 I78 2002).
- J. O'Malley, Schaum's Outline of Theory and Problems of Basic Circuit Analysis, 2nd Edition, 1992 (TK454 O46 1992).
- More references are posted on the course website.

Grading Policy:

Coursework will be weighted as follows:

Assignments (HWs)	5%
In-class (group) exercises	5%
Class Discussion/Participation	10%
Midterm Examination	40%
Final Examination (comprehensive)	40%

- The lowest in-class exercise score will be dropped. Similarly, the lowest assignment score will be dropped.
- Late assignments will be heavily penalized or rejected.
- Cheating will not be tolerated

Assignments: Homework will be assigned throughout the semester. For each assignment, only part(s) of a selected problem will be graded. Of course, you do not know which problem will be selected; so you should work on all of them. The complete solutions (not just answers) to all problems will be posted on the course web site.

In-Class Exercises: In-class exercises will focus on current and previous topics. An exercise may be given at any time during any class period. Students are expected to work in groups of four persons. There will be no make-up exercise.

Exams: An A4 study sheet is allowed. One side for the midterm exam. Another side for the final exam.

Students must notify the instructor before missing any exam if at all possible and immediately thereafter when not possible. The instructor (and/or the fact-finding committee) will determine if the absence from an exam is legitimate. Simply not feeling well is not a reason to miss an exam. In the case of legitimate absence, an oral and/or written make-up exam could be arranged.

Expectations: You should expect to spend extra 5-8 hours per week studying outside of class. However, I do expect you to come to class and *participate actively* in class discussions. If you must miss a class, I expect you to find out and catch up with what happened in lecture, either from me or one of your classmates. You are responsible for all materials that are discussed in class.

Academic Integrity: The work you submit in ECS 203 is expected to be the result of your individual effort. You are free to discuss course material, approaches to problems with your colleagues or the instructor but you should never misrepresent someone else's work as your own.

It is your responsibility to protect your work from unauthorized access. For example, do not discard copies of your programs/assignments in public places.

Course Outline

The following is a tentative list of topics with their corresponding chapters from the textbook by Alexander and Sadiku.

Topics	Textbook Chapter
1. Intro, math review, units, circuit variables, passive sign convention, circuit elements	1
2. Intro electric circuits: Ohm's law, node/branches/loops, Kirchhoff's Laws,	2
3. Resistive circuits, series/parallel resistors, voltage divider, current divider	2
4. Nodal analysis and mesh analysis	3
5. Linearity, superposition, source transformation	4
6. Thevenin's/Norton's equivalent circuits, maximum power transfer	4
7. Basic electronics: Op amps; Review	5
8. MIDTERM: 8 Mar 2016 TIME 13:30 - 16:30	
9. Op amps (cont.)	5
10. Capacitors and inductors; dc steady-state conditions	6
11. Sinusoids, phasors, complex number review, phasor relationships for circuit elements	9
12. Impedance and admittance, Kirchhoff's laws in frequency domain, impedance combinations,	9
13. Sinusoid steady-state analysis: nodal-mesh analysis, superposition theorem, source transformation, Thevenin/Norton equiv. circuits	10
14. AC power analysis: instantaneous and average power, maximum average power transfer, effective or RMS value	11
15. Introduction to three-phase circuits, first-order circuits, and second-order circuits. Review.	7, 8, 12, 13
16. FINAL: 19 May 2016 TIME 13:30 - 16:30	

last updated on January 10, 2016



Getting Info About This Course

Announcements

- The **syllabus** contains tentative information.
- I will announce **in class** and on the **web site** if there is any change.
- You are **responsible** for making sure that you obtain this information.
- Come to classes **on time** and listen carefully for **announcement(s)**.
- For those who want a preview of the class materials, old slides along with the notes and HWs from earlier years are also available on my web site (**prapun.com**).

Course Web Site

prapun.com

Current version

Teaching

- For 2/2015, he teaches
 - [ECS203](#) (Basic Electrical Engineering) (For non-major students)
 - [ECS452](#) (Digital Communication Systems)
- For 1/2015, he taught
 - [ECS315](#) (Probability and Random Processes)
 - [ECS332](#) (Principles of Communications)
 - [ECS204](#) (Basic Electrical Engineering Laboratory) (For non-major students)
- For 2/2014, he taught
 - [ECS203](#) (Basic Electrical Engineering) (For non-major students)
 - [ECS455](#) (Mobile Communications)
 - [ECS204](#) (Basic Electrical Engineering Laboratory) (For non-major students)
 - [ICT Elementary for Embedded Systems](#) (Fourier transform and principles of communications)
- For 1/2014, he taught
 - [ECS315](#) (Probability and Random Processes)
 - [ECS452](#) (Digital Communication Systems)

Last-year version



Asst. Prof. Dr. Prapun Suksompong (ผศ.ดร.ประพันธ์ สุขสมปอง) is currently a [faculty member](#) at [Sirindhorn International Institute of Technology \(SIIT\)](#), Thammasat University, [Thailand](#). In 1997, he received the [King's Scholarship](#) to study in the [School of Electrical and Computer Engineering \(ECE\)](#) at [Cornell university](#). He topped the [Cornell ECE class of 2002](#), with the highest GPA among all engineering students. He then received the Cornell's fellowship for his graduate study. Prapun joined Prof. [Toby Berger's](#) group in 2003 and got his Ph.D. in 2008.

Right after his graduation, he started his teaching career at SIIT. His research interest is in the areas of [communication theory](#), [information theory](#), [probability theory](#), and [theoretical neuroscience](#). In 2012, he (along with two other faculty members in the Wireless Communication Research Group) received the 2011 SIIT Research Award. In 2014, he received the 2013 Outstanding Young Researcher Award (รางวัลนักวิจัยรุ่นใหม่ดีเด่นระดับคณะ ประเภทอาจารย์) from Thammasat University.

[Ajarn](#) Prapun always highly values the teaching aspect of his career and his life. Many of his notes are available on his personal websites. In 2006, he received the Teaching Assistant of the Year Award from members of the Cornell IEEE Student Branch "for exemplary teaching in ECE". In 2010 and in 2014, he also received the Best Teaching Awards from SIIT.

For more information, [here is his CV](#). (Download [pdf version](#).)

Teaching

- For 2/2015, he teaches
 - [ECS203](#) (Basic Electrical Engineering) (For non-major students)
 - [ECS452](#) (Digital Communication Systems)
- For 1/2015, he taught
 - [ECS315](#) (Probability and Random Processes)
 - [ECS332](#) (Principles of Communications)
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- For 2/2014, he taught
 - [ECS203](#) (Basic Electrical Engineering) (For non-major students)
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 - [ECS204](#) (Basic Electrical Engineering Laboratory) (For non-major students)
 - [ICT Elementary for Embedded Systems](#) (Fourier transform and principles of communications)
- For 1/2014, he taught
 - [ECS315](#) (Probability and Random Processes)
 - [ECS452](#) (Digital Communication Systems)



Course Web Site

- Announcements
- References
- Handouts (Posted before corresponding lectures; also available at the copy center)
- Annotated Notes/Slides (Posted after corresponding lectures)
- Calendar
 - Exams
 - HW due dates

Please check the course website regularly.

www2.siit.tu.ac.th/prapun/ecs203/



ECS203: Basic Electrical Engineering

Synopsis
This course introduces basic electrical engineering principles and technology to students outside the electronics and communications curriculum.

Announcements

- The first lecture will be on Jan 12.
 - However, **the first tutorial session will be on Jan 18.**
- This site can be accessed via ecs203-prapun.com.
- A crude RSS feed is provided. You may find it useful for following class updates.
- Welcome to ECS203! Feel free to look around this site.

General Information

- Instructor:** Asst. Prof. Dr. Prapun Subsompong (prapun@siit.tu.ac.th)
- Course Syllabus:** (To be distributed in class)
- Office Hour:**
 - Office: B2C, 4th floor of Srinakharinwirot building
 - Office Hours (Tentative): M 14:00-18:00, R 10:30 - 11:30, F 14:00 - 15:00
 - Additionally, please feel free to ask any question or express any concern after class.
- Textbook:** C.K. Alexander and M.N.O. Sadiku, Fundamentals of Electric Circuits, 5th ed., McGraw-Hill, International Edition, 2012. (TK454 A452 2012)
 - Chapter 2 of the textbook is available [here](#).
- More References**
 - J. D. Van, Basic Engineering Circuit Analysis, John Wiley & Sons, 11E, 2015
 - 10E: 2002 (TK454 I78 2002).
 - A. Agarwal and J. Lang, Foundations of Analog and Digital Electronic Circuits, Morgan Kaufmann, 2005
 - Video lectures from MIT's 6.002 Circuits and Electronics.
 - J. O'Malley, Schwan's Outline of Theory and Problems of Basic Circuit Analysis, 2nd Edition, 1992 (TK454 O46 1992).

Handouts and Course Material

- Chapter 1 (Posted @ 11PM on Jan 10)

Problem Set

Note that, for each HW, only a part of ONE question will be graded. Of course, you do not know which one will be selected; so you should work on all of them.

HW#	Due Date	Remarks/Solutions
HW1		

Calendar

Reading Assignment

- Chapter 1: 1.1-1.6
- Chapter 2: 2.1-2.6
- Chapter 3: 3.1-3.3, 3.7
- Chapter 4
- Chapter 5: 5.1-5.3
- Chapter 6 (Capacitors and inductors): 6.1-6.3
- Chapter 9 (Sinusoids and Phasors): 9.1-9.7
- Chapter 10 (Sinusoidal Steady-State Analysis): 10.1-10.7
- Chapter 11 (AC Power Analysis): 11.1-11.6
- Chapter 7 (BC and RL Circuits): 7.1-7.3, 7.5, 7.6

Also... Links

- The Manga Guide to Electricity (excerpt)
- Video: Colin Cunningham explains Ohm's Law
- Video: The Capacitor
- Video: How inductors work
- Electrical systems in use in most countries of the world
 - Thailand: 220V 50 Hz
- Sinusoid: Phase and Time shifting a Cosine and a Sine - Sine Function
- Circuit Explains: How Electrostatics Really Kills You
- Using Wolfram-Alpha to solve DE
 - Specific Example
- Computer Control of AC Devices

Maintained by Dr. Prapun Subsompong

Course Website: Notes & Slides

- Some **PDF notes/slides** will be posted *before* the corresponding lectures.
 - Hard copies can be purchased from the **copy center**.
- In lectures...
 - PDF notes/slides will be highlighted and annotated with examples / comments.
 - These annotated materials will be **posted after** the corresponding lectures.
 - **Put all of your energy into understanding the material.**
- **Remind** (email) me the day after the lecture if the annotated notes/slides from the day before are still not posted on the web.

RSS Feed



<http://page2rss.com/page?url=www2.siiit.tu.ac.th/prapun/ecs203/index.html>

page²rss

[ECS203: Basic Electrical Engineering](http://www2.siiit.tu.ac.th/prapun/ecs203/index.html)

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<http://www2.siiit.tu.ac.th/prapun/ecs203/index.html> - Last Checked: 01/10/16 14:14:19 - Added: 07/05/10 01:42:38

10 Jan 2016 10:00

- The first lecture will on Jan 12.
 - However, the first tutorial session will be on Jan 18.
- [Course Syllabus](#) [To be distributed in class]
- Textbook [Fundamentals of Electric Circuit](#)
- More References
 - J. D. Irwin, [Basic Engineering Circuit Analysis](#), John Wiley & Sons, 11E, 2015
 - 10E: [2002](#) (TK454 I78 2002).
- [Chapter 1](#) [Posted @ 11PM on Jan 10]

[Permalink](#) | [View Entire Page](#)

05 Jan 2016 21:44

- [Course Syllabus](#) [To be distributed in class]
- - Office: [BKD, 4th floor of Sirindhalai building](#)
 - Office Hours (Tentative): M 14:00-16:00, R 10:30 - 11:30, F 14:00 - 15:00
 - Additionally, please feel free to ask any question or express any concern after class.



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page²rss

Course Organization

- **Course Web Site:**

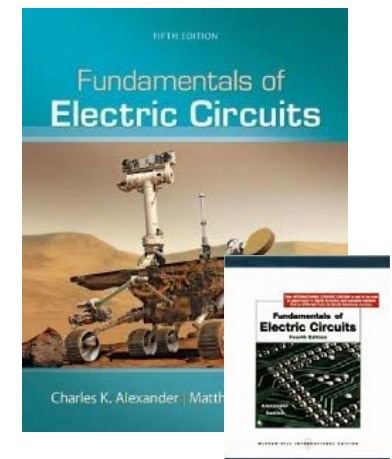
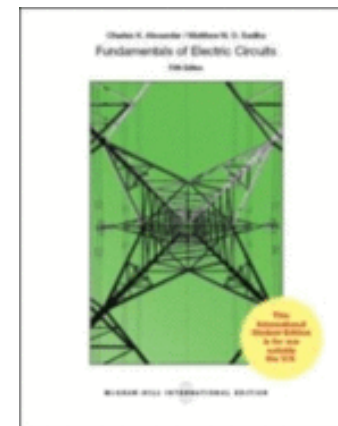
<http://www2.siit.tu.ac.th/prapun/ecs203/>

- **Lectures:**

Type	Time		Room
Lecture	Tuesday	13:00-14:20	BKD 2401
Lecture	Friday	10:40-12:00	BKD 3507
Tutorial	Monday	11:00-12:00	BKD 2506

- **Textbook:**

- **Fundamentals of Electric Circuits**
 - By C.K. Alexander and M.N.O. Sadiku
 - 5th ed., International Edition, 2013.
 - TK454 A452 2013



Course Outline

1. Intro, math review, units, circuit variables, passive sign convention, circuit elements
Intro electric circuits: Ohm's Law, node/branches/loops, Kirchoff's Laws,
2. Resistive circuits, series/parallel resistors, voltage divider, current divider
3. Nodal analysis and mesh analysis
4. Linearity, superposition, source transformation
Thevenin's/Norton's equivalent circuits, maximum power transfer
5. Basic electronics: Op amps; Review
6. Capacitors and inductors; dc steady-state conditions
7. Sinusoids, phasors, complex number review, phasor relationships for circuit elements
Impedance and admittance, Kirchoff's laws in frequency domain, impedance combinations.
8. Sinusoid steady-state analysis: nodal/mesh analysis, superposition theorem, source transformation, Thevenin/Norton equiv. circuits
9. AC power analysis: instantaneous and average power, maximum average power transfer, effective or RMS value
10. Introduction to three-phase circuits, first-order circuits, and second-order circuits.
Review.

General Ideas About This Course

- Provide new approach to the old concepts.
 - Some of you may have studied and solved some circuit analysis problems back in high school.
 - Most of you have studied (and probably suffered from) SCS139 (Physics II).
- This course will **provide a systematic** (step-by-step) **approach** to analyzing circuits.
- Most of you have studied the *digital* circuit elements from ECS371 (Digital Circuits).
 - This course considers *analog* elements.



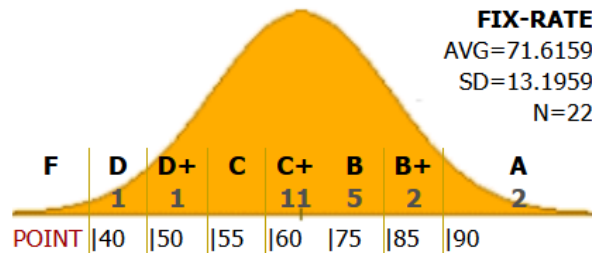
Grading System

- Coursework will be weighted as follows:

Assignments	5%
In-Class Exercises	5%
Class Participation	10%
Midterm Examination •8 Mar 2016 TIME 13:30 - 16:30	40%
Final Examination (comprehensive) •19 May 2016 TIME 13:30 - 16:30	40%

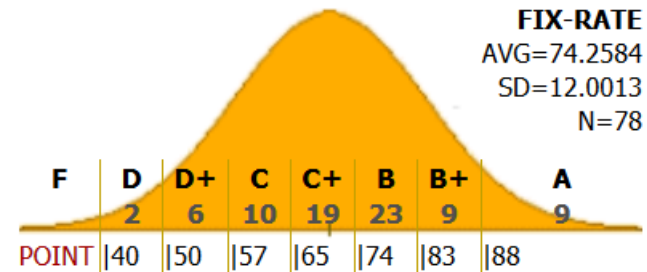
- Mark your calendars now!
- Late HW submission will be rejected.

Grading System



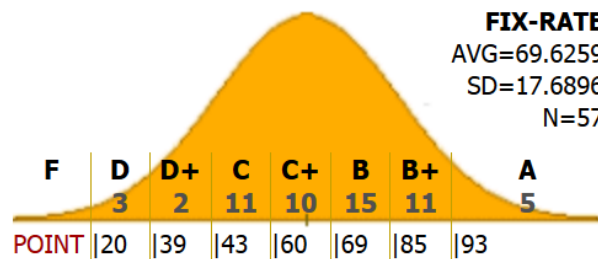
ECS303: 2009

CLASS GPA.: 2.75



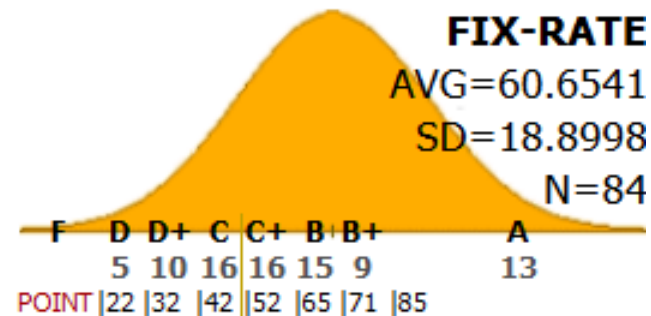
ECS203: 2013

CLASS GPA.: 2.76



ECS203: 2010

CLASS GPA.: 2.73

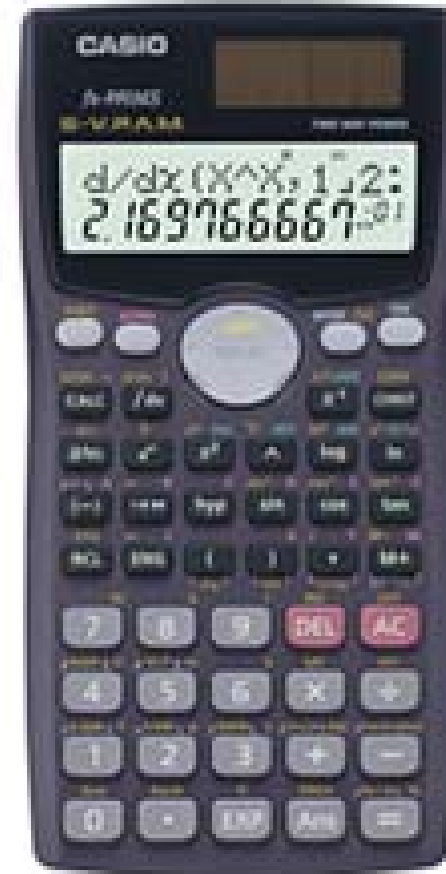


ECS203: 2014

CLASS GPA.: 2.63

Calculator

- You will need a calculator for both exams.
- At SIIT, Casio fx-991MS is allowed.
 - Make sure that you have one as soon as possible.
 - Use it when you work on the weekly assignments so that you can use it efficiently when taking the exams.





Calendar (Google)

Available on the course web site.

Today [Navigation] [Navigation] [Navigation] [Navigation] [Navigation] [Navigation] [Navigation]

Week Month Agenda

Sun	Mon	Tue	Wed	Thu	Fri	Sat
27	28	29	30 Announcement	31	Jan 1	2
3	4	5	6	7	8	9
10	11 Classes begin	12 13:00 ECS203 L	13	14	15 10:40 ECS203 L	16
17	18 11:00 ECS203 L	19 13:00 ECS203 L	20	21	22 10:40 ECS203 L	23
24	25 Last day to add	26 13:00 ECS203 L	27	28	29 10:40 ECS203 L	30
31	Feb 1 11:00 ECS203 L	2 13:00 ECS203 L	3	4	5 10:40 ECS203 L	6

Events shown in time zone: Bangkok

Google Calendar

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 - Video lectures from MIT's 6.002 Circuits and Electronics
 - J. O'Malley, Schaudt's Outline of Theory and Problems of Basic Circuit Analysis, 2nd Edition, McGraw-Hill, 1992.

Handouts and Lecture Material

- Chapter 1 (Posted on Jan 10)

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Calendar

Homework Assignment

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- Chapter 4
- Chapter 5: 5.1-5.8
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- Chapter 7 (BC and RL Circuits): 7.1-7.3, 7.5, 7.6

Misc. Links

- The Manga Guide to Electricity (excerpt)
- Video: Colin Cunningham explains Ohm's Law
- Video: The Capacitor
- Video: How inductors work
- Electrical systems in use in most countries of the world
 - Thailand: 220V 50 Hz
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- Circuit Explains: How Electrocuter Really Kills You
- Using Nodal-Alpha to solve DE
 - Specific Example
- Computer Control of AC Devices

Maintained by Dr. Prapun Sukkomong



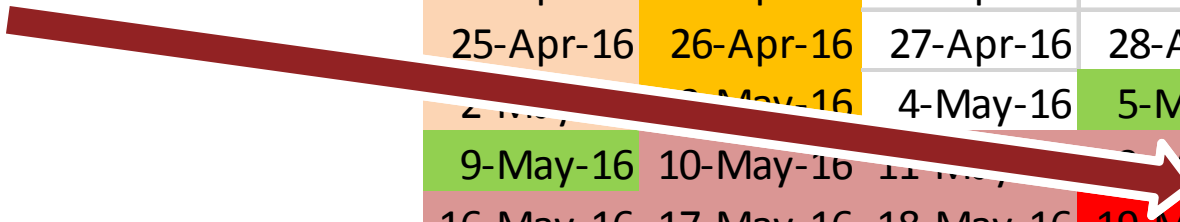
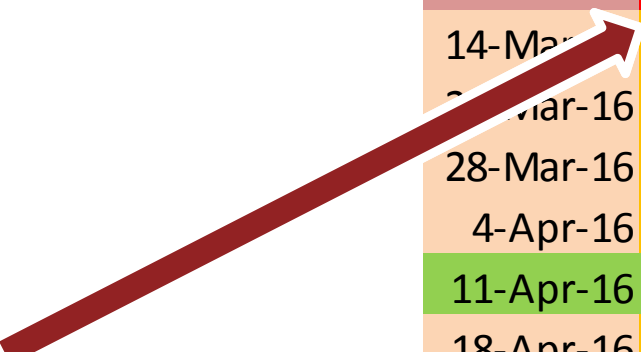
Calendar

Tutorial

Lectures

Exams

M	T	W	R	F
11-Jan-16	12-Jan-16	13-Jan-16	14-Jan-16	15-Jan-16
18-Jan-16	19-Jan-16	20-Jan-16	21-Jan-16	22-Jan-16
25-Jan-16	26-Jan-16	27-Jan-16	28-Jan-16	29-Jan-16
1-Feb-16	2-Feb-16	3-Feb-16	4-Feb-16	5-Feb-16
8-Feb-16	9-Feb-16	10-Feb-16	11-Feb-16	12-Feb-16
15-Feb-16	16-Feb-16	17-Feb-16	18-Feb-16	19-Feb-16
22-Feb-16	23-Feb-16	24-Feb-16	25-Feb-16	26-Feb-16
29-Feb-16	1-Mar-16	2-Mar-16	3-Mar-16	4-Mar-16
7-Mar-16	8-Mar-16	9-Mar-16	10-Mar-16	11-Mar-16
14-Mar-16	15-Mar-16	16-Mar-16	17-Mar-16	18-Mar-16
21-Mar-16	22-Mar-16	23-Mar-16	24-Mar-16	25-Mar-16
28-Mar-16	29-Mar-16	30-Mar-16	31-Mar-16	1-Apr-16
4-Apr-16	5-Apr-16	6-Apr-16	7-Apr-16	8-Apr-16
11-Apr-16	12-Apr-16	13-Apr-16	14-Apr-16	15-Apr-16
18-Apr-16	19-Apr-16	20-Apr-16	21-Apr-16	22-Apr-16
25-Apr-16	26-Apr-16	27-Apr-16	28-Apr-16	29-Apr-16
2-May-16	3-May-16	4-May-16	5-May-16	6-May-16
9-May-16	10-May-16	11-May-16	12-May-16	13-May-16
16-May-16	17-May-16	18-May-16	19-May-16	20-May-16



Class Participation

- NOT the same as class attendance!
- If you come only to **receive**, you will fall **asleep**.
 - Do not simply sit quietly in the class.
- Need **interaction** between lecturer and students.
- **Ask question** when there is something that you don't understand.
 - Don't be shy!
 - It is very likely that your friends don't understand it as well.
- If you already understand what I'm presenting, **SHOW ME!**
 - Point out the errors/typos.
 - I will raise many issues/questions in class. Try to comment on them.



Class Participation (2)

- Record what you have done.
 - Submitted before the midterm and before the final.

ECS 203: Self-Evaluation 2015

1. The class participation score for this class is judged by how much you actively participate in the class discussion both inside and outside of the classroom.
2. Please honestly answer the following questions. Please provide as much information as possible. Do not include the activities that you have already stated in the first self-evaluation form.

Name

Student ID

How many times have you been absent from the class? Are there any specific reason(s)? Please explain.

How many times have you been late (> 30s) for the class? Are there any specific reason(s)? Please explain.

How many times have you participated (provided comments, asked questions, answered questions, etc) in the lectures? Be specific. Provide some short description for each event. Number alone does not count.


How many times have you correctly informed the instructors the typo or mistake on the whiteboard/slides/hw/etc? Please provide some short description about each of the issues.

How many times have you discussed with the instructor outside of class? (Ask questions, express concerns, etc.) Be specific.



Based on the clock on my computer. (This should be approx. the same as your phone's and computer's clocks if they are synchronized properly.)

Policy

- We will start the class **on time** and will finish **on time**.
 - I recommend arriving at least 3 minutes before the start time.
 - Raise your hand and tell me immediately if I go over the time limit.
 - Does NOT mean that I will leave the room immediately after lecture.
 - I will stay and answer questions.
- Mobile phones *must* be turned off or set in silent mode. 
- We will have some in-class exercises. Some of these may occur without prior warning or announcement.
- Attendance will be taken/given irregularly and randomly.
- Cheating will not be tolerated.

Policy (con't)

- Feel free to stop me when I talk too fast or too slow.
- I will surely make some **mistakes** in lectures / HWs / exams.
 - Some amount of class participation scores will be reserved to reward the **first** student who inform me about each of these mistakes.
 - Grammatical errors are best informed/corrected after class.
- Points on assignments/exercises/exams are generally based on your entire solution, not your final answer.
 - You can get full credit even when you have the wrong final answer.
 - You may get **zero** even when you write down a right answer without justification.

Policy (con't)

- Please stop me if I go over the time limit.
- Please stop me if I talk too fast.
- Please stop me if you have any question.



Help and Office Hours

- Get some help!
 - Do not wait until the final exam time or after the grade is out.
 - Right after lecture is always a good time to ask question.
- Office Hours
 - Time: M 14:00-16:00, R 10:30-11:30, F 14:00-15:00
 - Appointment can be made.
 - Feel free to come to my office and chat!
 - Don't be shy.

Office Hours:

BKD, 4th floor of Sirindhralai building

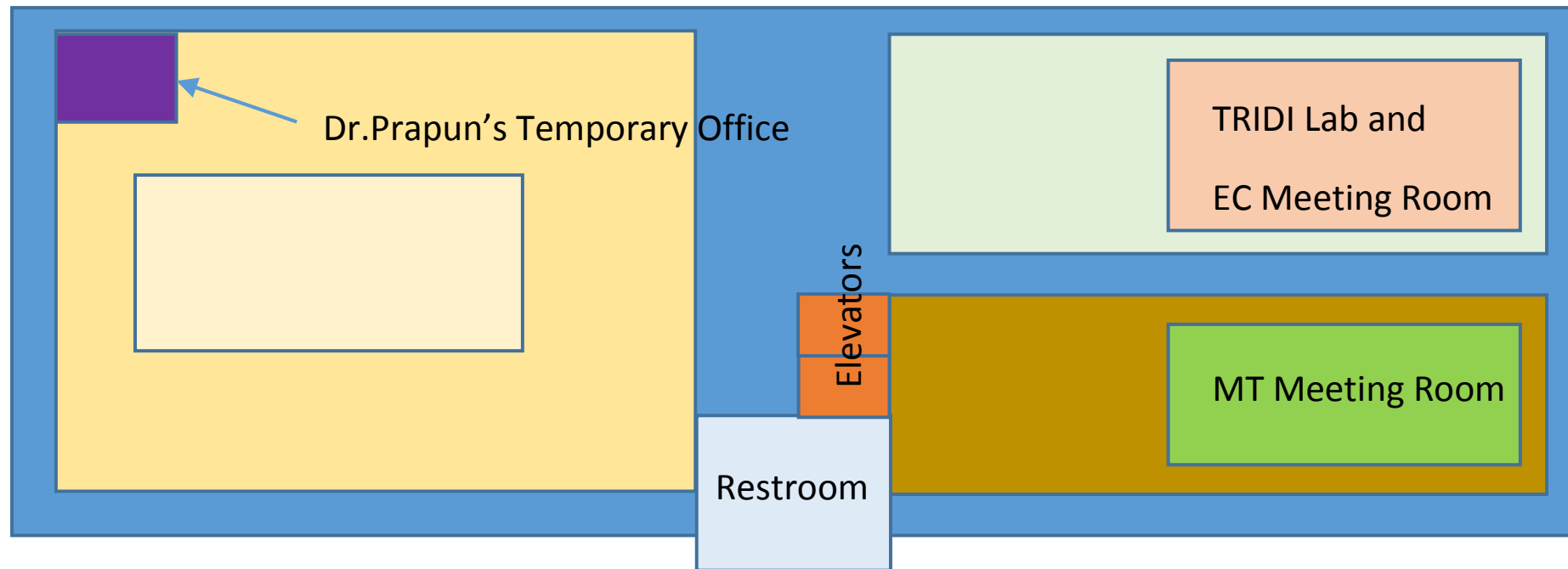
Monday **14:00-16:00**

Thursday **10:30-11:30**

Friday **14:00-15:00**

My (Temporary) Office

- Sirindhralai building
- 4th floor



Warning

- This class can be **difficult**.
 - Keep up with the lectures.
 - Make sure that you understand the concepts presented in the lecture before you go home.
- I will **evaluate** your understanding of the course **regularly** through
 - In-class exercises/activities
 - Weekly assignments
 - Exams

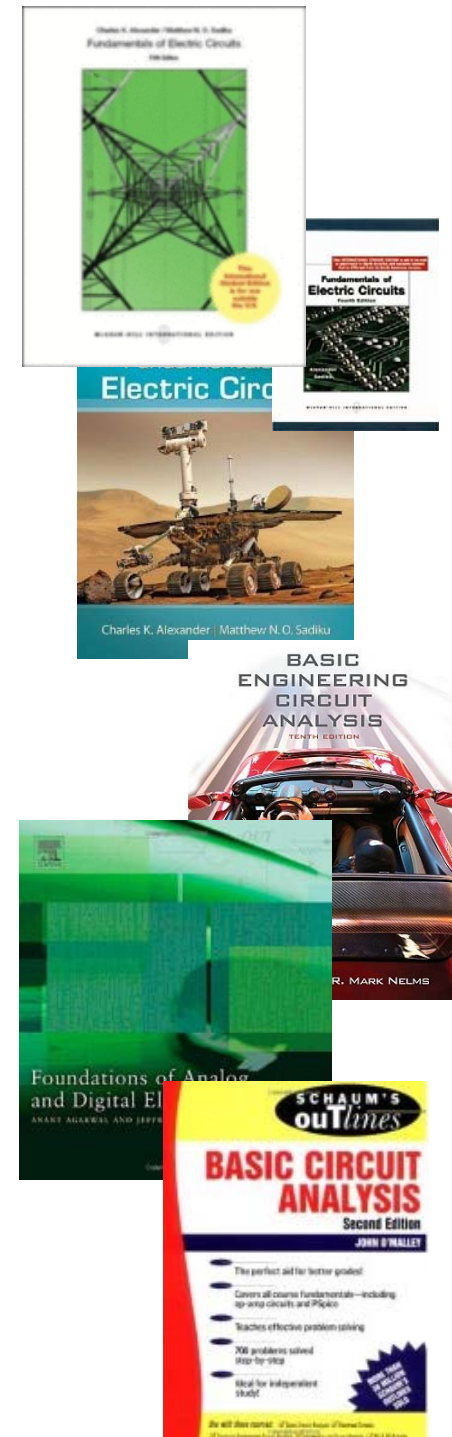


Remarks

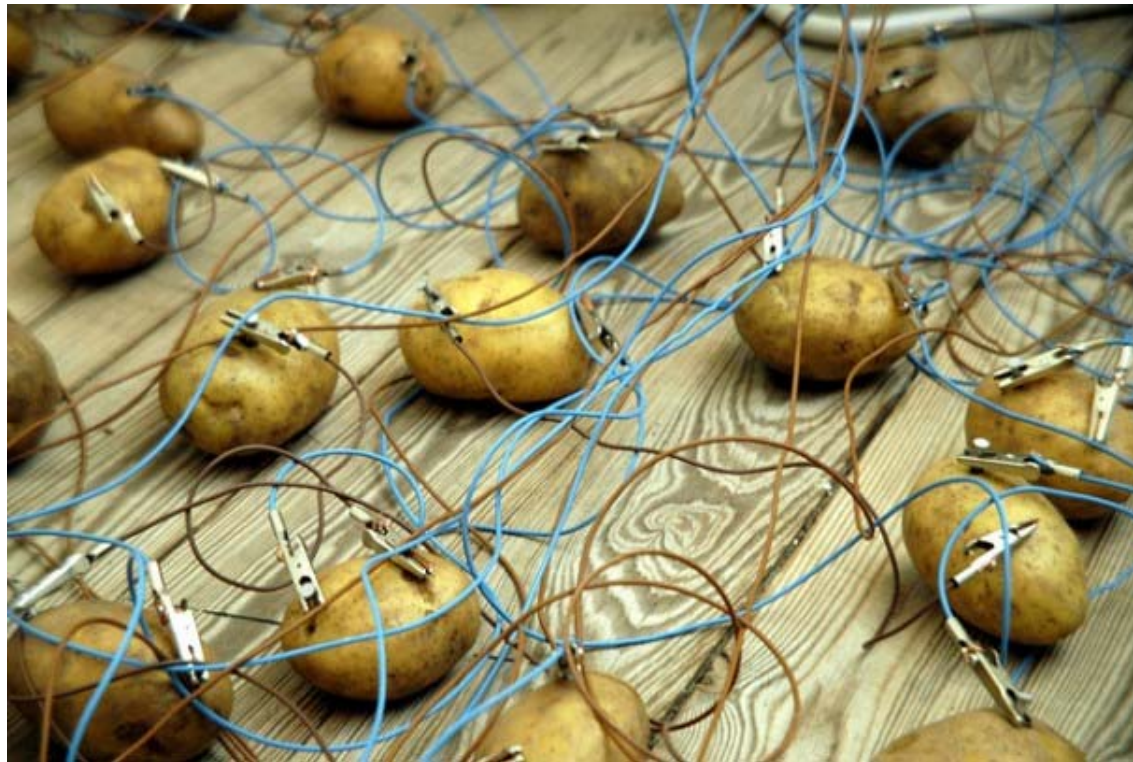
- Get as much **legitimate** help as you can
- **Participate actively in class** and outside of class
 - Record what you have done.
- If you feel that the class is very easy, you might overlook something.
- If you feel that the class is very difficult, you are probably not the only one who feel that way.
 - Don't give up. Chat with me.
- My notation can be different from the textbook.
 - Every notation has some advantages and disadvantages.

More Examples

- Check these references
- C.K. Alexander and M.N.O. Sadiku, Fundamentals of Electric Circuits, 5th ed., McGraw-Hill, International Edition, 2013. (TK454 A452 2013)
- J. D. Irwin, Basic Engineering Circuit Analysis, John Wiley & Sons, 2002 (TK454 I78 2002).
- A. Agarwal and J. Lang, Foundations of Analog and Digital Electronic Circuits, Morgan Kaufmann, 2005
- J. O'Malley, Schaum's Outline of Theory and Problems of Basic Circuit Analysis, 2nd Edition, 1992 (TK454 O46 1992).

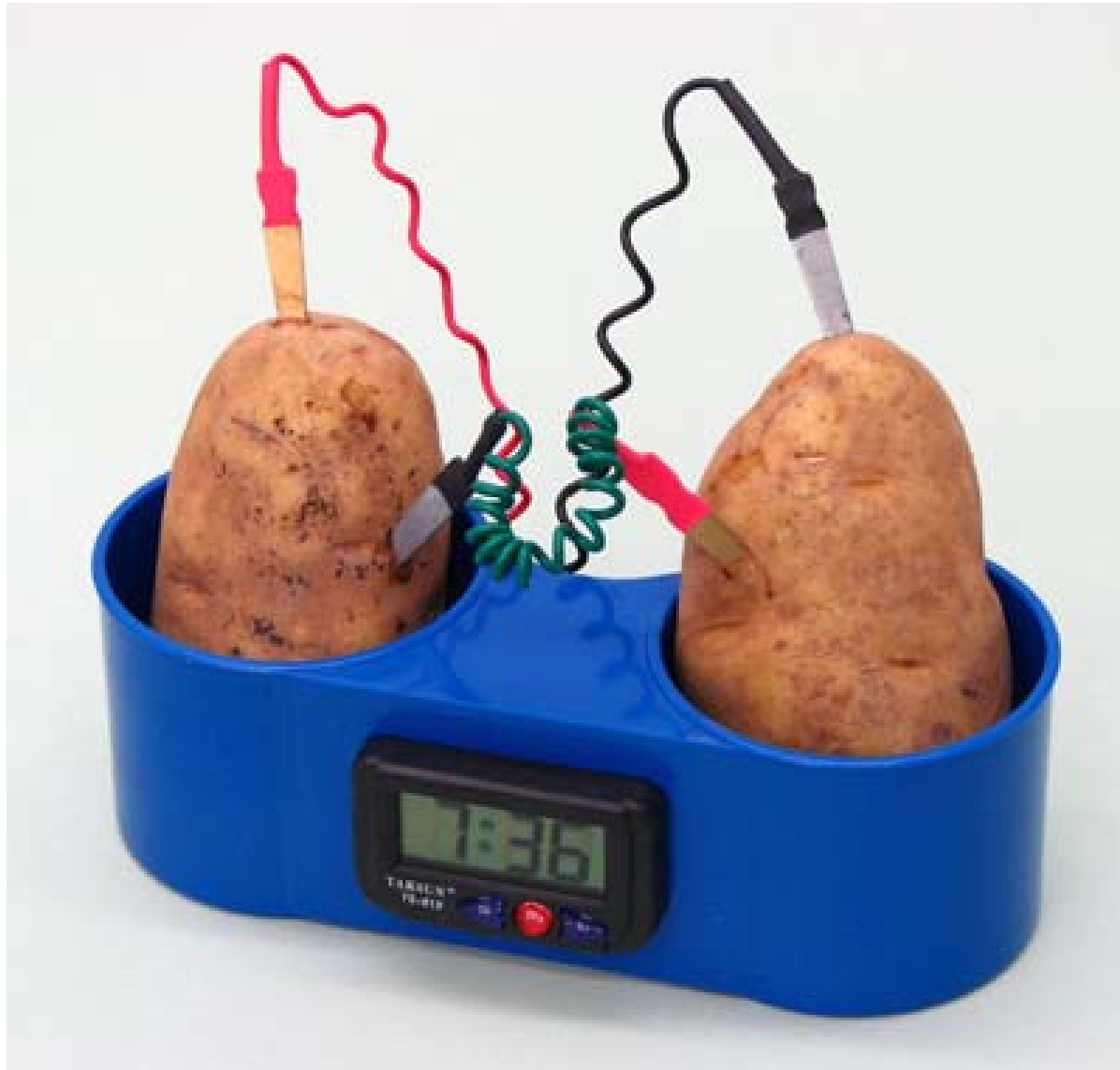


SORRY FOR THE LONG DISCUSSION OF THE ADMIN. STUFF



HERE'RE POTATO BATTERIES.

Potato Clock



Potatoes Can Be Used To Charge Your Gadgets

(Boiled potatoes are even better.)



- <http://www.smithsonianmag.com/innovation/a-potato-battery-can-light-up-a-room-for-over-a-month-180948260/?no-ist>
- <http://wonderfulengineering.com/potatoes-can-be-used-to-charge-your-gadgets/>
- <https://www.youtube.com/watch?v=36hzlFVgVa8>
- <https://www.youtube.com/watch?v=FITxr6bJmd8>