332:221 Principles of Electrical Engineering I – Fall 2009

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Office hours: Monday and Thursday: 1:00 PM to 3:30 PM or by appointment.

Course Website: `www.ece.rutgers.edu/~psannuti,`
`e-companion can be reached via http://rutgersonline.net/`.

Prerequisite: 01:640:152 Calculus for Mathematical and Physical Sciences
Co-requisite: 01:640:251 Multivariable Calculus

Text: Electric Circuits by James W. Nilsson and Susan A. Riedel, Seventh or Eigth Edition, Prentice Hall

Syllabus: Chapters 1 to 6, 9 and 10 of the above text.

Principles of Electrical Engineering is exactly what its name implies. If you learn the basic principles, the rest of Electrical Engineering follows quite easily. The subject builds up sequentially, and thus each lecture builds on the previous lectures. If you are not in synchronism with the course, it takes a much grater effort to catch up with the course. Make every effort to be up to date so that you can get the most out of the lectures. **Seek help when you need it by coming to office hours, do not postpone seeking help**.

Work habits: Attendance in the course is not compulsory if you do not want to take quizzes, and thus lose receiving credit for them. All the exams in the course require comprehensive knowledge of the subject. Unless you attend the class regularly and learn the fundamental concepts and practice them by doing Home-Work, it would be hard to get a good grade.

Exams: There will be two hourly exams, and a final exam. The **first and second hourly exams** will be tentatively given during the class on **Thursday October 1st** and **Monday November 2nd** respectively. The material covered and the seating arrangement for these exams will be announced in the class. According to the university Final Exam schedule, **the final exam** for this course is scheduled on Friday, Dec 18th from 8:00 AM to 11:00 AM. However, depending on the availability of class room(s), there is a chance that it could be rescheduled or an hourly exam will be given in place of final exam. **No make up exams will be given**. If you have a medical excuse, consult Dean Bernath.

Grading: The course grade is based on the two hourly exams, final exam or another hourly exam at the end, some collected Home-work (see below), and n number of unannounced quizzes. (There are no makeup quizzes even if you have a valid excuse.) Quizzes are simple and are like 'Assessing Objective' problems in the text book.
Grade distribution: 25 % Exam 1, 25 % Exam 2, at least 15 % for collected and graded Home-work, 2 % for each Quiz, the rest for final exam or another hourly exam at the end.

PSPICE & **Multisim:** As a part of lab, you need to work with PSPICE or Multisim, circuit simulating software. A tutorial lecture will be conducted on PSPICE and Multisim in the evening (dates are to be announced). Two files, one containing the basics of PSPICE and the other the basics of Multisim can be found at the Course Website,
`www.ece.rutgers.edu/~psannuti`.

Data of teaching assistants: To be announced.

Practical perspective problems: The text book has several practical perspective problems. Unfortunately, we cannot budget class time to do all such problems. We concentrate in the course to drill on all the basic fundamentals of 'Circuit Analysis'. Some of the students say what they learn in 'Circuit Analysis' is just theory. It is not so. In fact, all the practical perspective problems given in the text book show that practical applications require a thorough understanding of circuit theory. So, the aim of the course is to drill as much as possible understanding circuit theory. Certain assigned Home Work Problems contain design issues that arise in practice.

Nature of Course: Circuit Analysis can be learned only by solving problems and getting to know the basic principles over and over. It is not advisable to remember formulae, except the very basic ones, such as equivalent impedance (resistance) of those impedances (resistances) connected in series or in parallel, voltage division, current division, etc. Remembering formulae does not work out, and it is like remembering sentences to speak a language rather than formulating sentences as it is spoken (one cannot remember all possible sentences for all possible situations).

Sketchy Class Notes: I used to distribute class notes during each lecture. One problem doing so was that some students do not attend classes by merely thinking that they could simply read the notes. Obviously, this is not a good prospect; why reading notes is any better than reading the text book itself if you do not attend classes? The reason behind distributing the notes was simple; if you heard the concepts in the class, and highlights of the lecture are presented in the notes, it would then help reading the notes to recollect the concepts. If you never heard a lecture, it is better to read the text book itself. With this in mind, I did not distribute any notes during Fall 08. This caused a small problem which was compounded by my habit of coming early before class starts and filling the board with the conceptual summary of lecture or with some circuit diagrams that are analyzed during the lecture. Some students commented that they cannot simultaneously copy what is written ahead on the board and listen to the lecture as well. To solve this problem, this semester I placed a file called Sketchy-class-notes for each chapter in ecompanion. As the name implies, the notes is sketchy, it has some important aspects of the course and all circuit diagrams we deal with in the lectures but it does not contain everything. If you bring the printed or electronic version of the notes, you can fill the missing parts next to each circuit diagram. This eliminates or reduces the time needed to copy circuit diagrams and some notes, and thus hopefully this enhances your learning.

Assigned Home-work – Collected: There is assigned Home-work that is collected and graded. A pdf file containing all the assigned HW that is collected and graded is placed in `e-companion which can be reached via http://rutgersonline.net/`.

Assigned Home-work – Not collected: There are two kinds of assigned home-work which is not collected. A pdf file containing some notes and some home-work problems is placed in `e-companion which can be reached via http://rutgersonline.net/`. This file contains solutions to most of the problems. Also, some chapter end problems and the solutions as given by the authors of the text book are placed in e-companion. In this connection, the Eight-th edition of the book does not have a student version of solution manual for the problems. I posted the assigned problems and their solutions for the seven-th edition. **Although solutions are provided, one should not simply read the problem and its solution**. **If you do so, you will not learn any thing**. Note that one cannot learn driving by simply watching

others drive. You must be in the driver seat to learn driving. It is so also in learning circuit analysis. You must first attempt to solve each problem by yourself. Only as a last resort, you should consult the solution. If you still do not understand the solution, you must then discuss your difficulties with TAs and the faculty member. **Help is available all the time, but you must seek it.** Otherwise, TAs and the faculty member do not know your difficulties. The assigned Home-work is the minimum you need to do. You are encouraged to do Assement problems and all other Chapter end problems as well.
Seek help, you are already paying for it.

ABET COURSE SYLLABUS: This can be found at
`http://www.ece.rutgers.edu/degree/under/ug_course_descriptions`.

The goal and other aspects of the of the course can be found in the syllabus posted at `www.ece.rutgers.edu/~psannuti,` and at e-companion.

Goal

The goal of the course is to expose the students to various concepts in Electrical Circuit Analysis. The important concepts are listed below.

1. Voltage, Current, Power, Energy, Conservation of power in a circuit.

2. Ideal voltage and current sources, Independent and dependent sources.

3. Resistance and Ohm's law.

4. Kirchoff's Current Law (KCL) and Kirchoff's Voltage Law (KVL).

5. Analysis of simple circuits using KCL and KVL.

6. Circuit analysis with resistors in series and parallel.

7. Voltage divider and current divider circuits, effect of a load.

8. Voltmeter and Ammeter construction from a galvanometer.

9. Δ-Y transformations.

10. Attenuators.

11. Node voltage Analysis.

12. Mesh current Analysis.

13. Source transformations.

14. Thevenin and Norton equivalents of a circuit between any two given nodes.

15. Superposition theorem in linear circuits.

16. Maximum power transfer from the circuit to a load.

17. Operational Amplifier (Op-Amp); Ideal model of an Op-Amp, Inverting amplifier, Non-inverting amplifier, differential amplifier circuits; effect of a load, Analysis of Op-Amp circuits with a more realistic model of Op-Amp.

18. Capacitance, Inductance and Mutual inductance.

19. Sinusoidal Steady State Analysis, Concepts of a Phasor and an Impedance, Circuit analysis with Phasors and an Impedances.

20. Sinusoidal Steady State Power calculations, RMS or effective value, Average power, Real and Reactive powers, Complex power, Power triangle, Conservation of real and reactive powers, maximum power transfer.

21. Ideal transformer voltage and current relation-ships between primary and secondary windings.

In order to assess how well the students understand the above concepts, examination problems are constructed reflecting most of the important concepts outlined above. During the Fall semester 2004, examination problems included the concepts as outlined below:

Quiz 1: Simple circuit analysis involving the concepts of voltage, current, power, independent and dependent sources, KCL and KVL.

Quiz 2: Series, parallel, and Δ-Y equivalents.

Quiz 3: Construction of Thevenin equivalent circuit, Nodal Analysis, and Mesh current Analysis.

Quiz 4: Ideal analysis of a cascaded Op-Amp circuit.

Quiz 5: Conversion from time domain to phasor domain, Nodal Analysis in phasor domain, and conversion back to time domain.

Quiz 6: Conversion from time domain to phasor domain, Mesh current Analysis in phasor domain, and conversion back to time domain.

Hourly Exam 1, Problem 1: Solving a simple circuit with independent and dependent sources, demonstration of power balance.

Hourly Exam 1, Problem 2: Solving a simple circuit by one of the three possible methods, (1) by simplifying it using series and parallel resistance equivalents, (2) by Nodal Analysis, and (3) by Mesh current Analysis.

Hourly Exam 1, Problem 3: Determination of equivalent resistance between two nodes by utilizing series and parallel resistance equivalents as well as Δ-Y equivalents.

Hourly Exam 1, Problem 4: Construction of a voltmeter and modification of a voltmeter.

Hourly Exam 1, Problem 5: Writing all the independent equations involving node voltages of a complex circuit.

Hourly Exam 1, Problem 6: Writing all the independent equations involving mesh currents of a complex circuit.

Hourly Exam 2, Problem 1a: Determination of open circuit voltage between two nodes of a circuit using mesh current analysis.

Hourly Exam 2, Problem 1b: Determination of short circuit current between two nodes of a circuit using node voltage analysis.

Hourly Exam 2, Problem 1c: Determination of Thevenin resistance between two nodes of a circuit using test voltage and test current method.

Hourly Exam 2, Problem 2: Ideal analysis of a cascaded Op-Amp circuit.

Hourly Exam 2, Problem 3: Non-ideal analysis of an Op-Amp circuit.

Hourly Exam 2, Problem 4a: Behavior of a capacitance under a known periodic input voltage across it.

Hourly Exam 2, Problem 4b: Power calculations with sinusoidal voltage and current.

Hourly Exam 2, Problem 5: Determination of a simple equivalent circuit of a complex circuit.

Final Exam, Problem 1: Solving a simple circuit with independent and dependent sources, demonstration of power balance.

Final Exam, Problem 2: Node Voltage Analysis of a resistive circuit.

Final Exam, Problem 3: Mesh Current Analysis of a resistive circuit.

Final Exam, Problem 4: Non-ideal analysis of an Op-Amp circuit.

Final Exam, Problem 5: DC Steady State Analysis of a circuit.

Final Exam, Problem 6: Mesh Current Analysis of a circuit in phasor domain.

Final Exam, Problem 7: Node Voltage Analysis of a circuit in phasor domain.

Final Exam, Problem 8: Determination of Thevenin impedance between two nodes of a circuit using test voltage and test current method in phasor domain.

Final Exam, Problem 9: Phasor domain Analysis of a circuit and conservation of real and reactive powers.

Final Exam, Problem 10: Writing Mesh Current equations when mutual inductances are present.

Final Exam, Problem 11: Determination of equivalent impedance between two nodes when ideal transformer is present.