ELEC2134
Circuits and Signals

COURSE INTRODUCTION — Session 2, 2009

Course Staff
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Course details

Credits
The course is a 6 UoC course; expected workload is 10-12 hours per week throughout the 13 week session.

Contact hours
The course consists of 2 hours of lectures, a 1-hour tutorial and a 3-hour laboratory session each week.

Lectures: Monday, 10 am–11am, room EEG25
Tuesday, 3pm–4pm, room EEG25
Tutorials: Monday, 11am-12pm, room EE222
Tuesday, 4pm-5pm, room EE222
Wednesday, 4pm-5pm, room EE222

Consultations: You are encouraged to ask questions on the course material after the regular class times at the lecture venue or in the tutorials in the first instance, rather than by email.

Course Information

Context and aims

Electrical Engineering is concerned with three primary activities: the first deals with electricity and its direct control and use within electrical circuits (are they used for power systems, electronics, instrumentation, communications and so on). The second activity is concerned with modelling systems which use electricity as the primary source of energy for functioning. The third activity concerns the handling of data which relies on electrical
phenomena (wired and wireless) for data transmission. This course provides the fundamental techniques for carrying out the first two activities.

**Aims:** This course aims to:

a. Familiarise with basic understanding of electronic components on which analysis and design of electronic circuits and systems are based, including operational amplifiers.

b. Provide the ability to formulate and solve the differential equations describing the time behavior of the first and second order circuits.

c. Provide the capability to design and construct circuits, take measurements of circuit behavior and performance, compare with predicted circuit models and explain discrepancies.

d. Introduce a system-based approach for solving linear circuits using the Laplace transform.

**Relation to other courses**

This course builds on the year 1 course in Electrical Engineering ELEC1111 which introduced concepts of fundamental electricity and electrical circuits. It provides the basis for all the future compulsory and elective courses in the signal processing, control, energy and communication area, as well as those involving more advanced electric circuit design.

**Pre-requisites:** The minimum pre-requisite for the course is ELEC1111, MATH 1231 and MATH 1241.

**Assumed knowledge:** It is essential that the students have a good computer literacy, and they are strongly advised to revise previous ELEC1111 course materials as quickly as possible to avoid difficulties in this course.

**Learning outcomes**

On successful completion, the students should:

1. Be able to develop and employ circuit models for elementary electronic components, e.g. resistors, sources, inductors, and capacitors.

2. Become expert at using various methods of circuit analysis, including simplified methods such as series parallel reduction, voltage and current dividers, and the node method.

3. Know how to analyze the first and second order linear circuits containing memory elements;
4. Fully understand the concept of sinusoidal-steady-state and using the impedance method to analyze the sinusoidal-steady-state response of first and second-order electronic circuits;
5. Gain an understanding of the role of the power flow and energy storage in electronic circuits at a specific instant of time.
6. Have an intuitive insight into the behavior of a physical system driven near resonance, in particular the relationship to the transient response and the significance of the quality factor Q;
7. Be able to use the Laplace transform in linear circuits to solve the differential equations and calculate the frequency response.
8. Become familiar with the concept of four-terminal or two-port devices and know how to analyze them using transfer impedance parameters.
9. Gain practical experience in the use of computer design and analysis tools such as MATLAB and PSPICE.

The course delivery methods and course content address a number of core UNSW graduate attributes; these include:
- a. The capacity for analytical and critical thinking and for creative problem-solving, which is addressed by the tutorial exercises and laboratory work.
- b. The ability to engage in independent and reflective learning, which is addressed by tutorial exercises together with self-directed study.
- c. The skills of effective communication, which are addressed by the viva-style verbal assessment in the laboratory.
- d. Information literacy, which is addressed by the assignments.

Please refer to http://www.ltu.unsw.edu.au/content/userDocs/GradAttrEng.pdf for more information about graduate attributes.

**Teaching strategies**
The course consists of the following elements: lectures, tutorials, laboratory work, and assignments

**Lectures**
The lectures provide the students with the explanation of the core material in the course. Numerous examples of analysis and design of simple to moderately complex electric circuits using a variety of methods are discussed in order to convey a qualitative understanding of the electric circuits. Students are expected to attend the lectures and prepare themselves for them.

**Tutorials**
The tutorials enable students to apply various methods to analyze and design electric circuits. Students are expected to attend the tutorials and attempt to solve given tutorial questions before attending the tutorial.

**Laboratory work**
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Starting in week 2, the laboratories provide the student with hands-on experience to design, analyze and test the electric circuits. Students will also learn how to use MATLAB and PSPICE for circuit analysis. Students must come prepared for laboratory sessions. During the laboratory, you may consult with others in the class, but you must keep your own notes of the laboratory and you will be assessed individually. In particular, note that laboratory assessment will be conducted individually, not on a per-group basis. Please also note that you must pass the laboratory component in order to pass the course.

Assignment
There will be two assignments throughout the semester which evaluates understanding of a given topic that the students will have to self-study.

Quizzes: There will be two quizzes conducted during the lecture time in the interval of weeks 2 to 11. These short examinations provide you with the feedback on your strengths and weaknesses which assists the learning process and thereby sustains a sense of motivation and interest.

Final examination: The exam in this course is a standard closed-book 3 hours written examination, comprising five compulsory questions. University approved calculators are allowed. The examination tests analytical and critical thinking and general understanding of the course material in a controlled fashion. Questions may be drawn from any aspect of the course, unless specifically indicated otherwise by the lecture staff. Please note that you must pass the final exam in order to pass the course.

Assessment
Laboratory work: 20%
Assignment: 10%
Quizzes: 20%
Final examination: 50%

Course Schedule

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<thead>
<tr>
<th>Week</th>
<th>Lecture</th>
<th>Reference (Chapters)</th>
<th>Tutorials</th>
<th>Laboratory</th>
</tr>
</thead>
<tbody>
<tr>
<td>1, 20th July</td>
<td>Ohm’s Law, Simplifying networks, Kirchhoff’s laws,</td>
<td>1,2</td>
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<tr>
<td>2</td>
<td>Nodal analysis ,Mesh analysis</td>
<td>3, 4</td>
<td>1</td>
<td>Introduction to Elvis and PSpice</td>
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<tr>
<td>3</td>
<td>Thevenin and Norton equivalents, Superposition</td>
<td>5,6</td>
<td>2</td>
<td>Using Matlab and PSpice for Circuit Analysis</td>
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<tr>
<td>4</td>
<td>Operational amplifiers, Capacitors and Inductors.</td>
<td>7</td>
<td>3</td>
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<tr>
<td>5</td>
<td>Transient response in first order RLC circuits</td>
<td>8</td>
<td>4</td>
<td>Superposition Theorem</td>
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<td></td>
<td>Transient response in second order RLC circuits</td>
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<td>Introduction to Operational Amplifiers</td>
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<td>7</td>
<td>Sinusoidal signals, sinusoidal steady-state analysis of circuits</td>
<td>11</td>
<td>Step Response of an RLC circuit</td>
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<tr>
<td>8</td>
<td>AC power analysis</td>
<td>14</td>
<td>RLC Series Circuit Resonance</td>
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<td>9</td>
<td>Frequency Response, Resonant circuits</td>
<td>15</td>
<td>Op-amp filters</td>
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<td>10</td>
<td>Introduction to Laplace transform</td>
<td>15</td>
<td>Network Synthesis</td>
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<tr>
<td>11</td>
<td>Applications of the Laplace transform</td>
<td>16</td>
<td>No tutorial</td>
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<td>12</td>
<td>Two-port networks</td>
<td>19</td>
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<tr>
<td>13</td>
<td>No lecture</td>
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**Resources**

**Textbooks**

**Prescribed textbook**

The following textbook is prescribed for the course:


**Reference texts**

The following books are good additional resources for this course:


**On-line resources**

Some additional on-line resources relevant to the course:

Course webct

http://vista.elearning.unsw.edu.au

Library resources

http://info.library.unsw.edu.au/web/services/teaching.html

book websites

http://www.mhhe.com/alexander


MATLAB

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Computer resources
Matlab and PSpice

The laboratories make use of these programs. It is advantageous for students who have their own computers to install Matlab and PSpice, as these programs will be useful not only in ELEC2134 but also in courses in subsequent years of the course. A CD containing Matlab and PSpice may be borrowed overnight (against a student card) from room EE G15A. PSpice is also available for download from many internet sites. For those students who do not have their own computers, access to these two programs is available in the undergraduate computer laboratory (EE G16).

Other Matters
Academic Honesty and Plagiarism
Plagiarism is the unacknowledged use of other peoples work, including the copying of assignment works and laboratory results from other students. Plagiarism is considered a serious offence by the University and severe penalties may apply. For more information about plagiarism, please refer to http://www.lc.unsw.edu.au/plagiarism

Continual Course Improvement
The course is under constant revision in order to improve the learning outcomes of its students. Please forward any feedback (positive or negative) on the course to the course convener or via the Course and Teaching Evaluation and Improvement Process (surveys at the end of the course).

Administrative Matters
On issues and procedures regarding such matters as special needs, equity and diversity, occupational health and safety, enrolment, rights, and general expectations of students, please refer to the School policies, see http://scoff.ee.unsw.edu.au/.