School of Electrical Engineering & Telecommunications
University of New South Wales

ELEC3105 – ELECTRICAL ENERGY

Course Outline

Lecturer: Colin Grantham
Location: Room EE133
Laboratory: Gamini Liyadipitiya (In-charge)
Tutors: Gilbert Foo

Course Objective:

The subject introduces the fundamental elements of generation, transmission, distribution and utilization of electrical energy. Circuits and devices associated with these fundamental elements are analyzed with a view to understanding their design, performance and selection. Analyses of single and three-phase AC circuits, transformers for power transmission, energy conversion principles, various types of AC and DC machines for power generation and utilization are covered. Environmental impacts of electricity, its safety issues and methods of protection are also covered. Power loss, heat generation, insulation classes and management of these are also dealt with. A brief introduction to power electronic circuits which transform the basic utility supply to the requirements for utilization in industrial and domestic loads will also be included.

Opportunities:

The subject is intended for those who may want to work in environments where all aspects of the design, application and maintenance of power apparatus, circuits and systems may have to be undertaken. The emphasis of the course will be a basic understanding of widely used devices and circuits in the power utility and utilization systems.
**Assessment:**

65% from final examination  
20% from laboratory experiments and reports  
15% from mid-session test

There will be a mid-session test for the course in week 7 (i.e. before the session break). The test will cover material from the lectures and tutorials during the first six weeks of the course. The final examination will cover ALL sections of the lecture notes and tutorials including those from the first six weeks of the course.

**Topics covered and Lecture Schedule:**

Lectures for the course will follow the following schedule approximately:

<table>
<thead>
<tr>
<th>Section</th>
<th>Topic</th>
<th>Hours</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Overview of power generation, transmission and distribution of electrical energy systems. Review of magnetic circuits</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>Calculation of power in AC circuits, three-phase circuits</td>
<td>3</td>
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<tr>
<td>3</td>
<td>Transformers</td>
<td>6</td>
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<tr>
<td>4</td>
<td>Principles of energy conversion, machine windings, mmf distribution, mechanism of torque and back-emf production, considerations for motor, generator applications and machine behaviour on load.</td>
<td>3</td>
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<tr>
<td>5</td>
<td>The DC machine</td>
<td>6</td>
</tr>
<tr>
<td>6</td>
<td>The induction machine</td>
<td>6</td>
</tr>
<tr>
<td>7</td>
<td>The synchronous machine</td>
<td>5</td>
</tr>
<tr>
<td>8</td>
<td>Introduction to power electronics</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td><strong>Total hours</strong></td>
<td><strong>36</strong></td>
</tr>
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</table>
Course Webpage:

All lecture notes, tutorial and laboratory sheets for this course can be found on the school webpage, via Current Students → Study Notes → Lecture Notes → ELEC3105. You may have to supply username: your student #, e.g., s1234567 and password: ee&tview, in order access these pages. Students will be expected to bring the printed lecture notes, tutorial sheets and laboratory sheets into the lecture/tutorial/lab classes as appropriate.

Lecture Notes for ELEC3105 Electrical Energy 1 are available from the School Lecture Notes website for the course.

Please ask the School Office if you have difficulty in accessing the notes.

Textbooks:

1. Electrical Machinery Fundamentals
   Author: Stephen J. Chapman (fourth edition)
   Publisher: McGraw Hill

   Author: P. C. Sen
   Publisher: John Wiley and Sons

3. Fundamentals of Electric Circuits
   Authors: C. K. Alexander and M. N. O. Sadiku
   Publisher: McGraw-Hill Higher Education

4. Electric Machines and Power Systems
   Author: V. D. Toro
   Publisher: Prentice-Hall

Further Reading:

The following books may be consulted for further reading by those who really want to explore further.

1. Alternating Current Machines by M. G. Say for sections 1-4
2. Electric Machines and Drives by G. R. Slemon for sections 1-5 and 7
3. Power Electronics by Daniel W. Hart for section 7
4. Analysis of Electric Machinery by Paul Krause for sections 1-4
Laboratory:

The laboratory for this course consists of the following five three-hour experiments to be carried out in room EE119, starting from Week 2.

   Experiment 1. Balanced Three-Phase Circuits.
   Experiment 2. The Power Transformer.
   Experiment 3. The DC Motor.
   Experiment 4. The Three-Phase Induction Motor.
   Experiment 5. The Synchronous Machine.

Because of the heavy pressure on laboratory resources, time and personnel, it will be very difficult for the School to reschedule laboratories once missed. The laboratory time-table and schedule produced by the School Office will therefore be followed strictly. LATE ENTRY BY MORE THAN 10 MINUTES INTO THE LABORATORY WILL NOT PERMISSIBLE.

You are advised to read the General Instructions for Laboratory carefully before coming to the laboratory for the first time.

You are also required to submit a declaration that you have read all safety related materials that were handed out to you, or you were advised to read. You will need to bring this declaration to the laboratory the first time you attend the laboratory.

Assessment of Laboratory:

Attendance of and performance in laboratory classes will be assessed by laboratory demonstrators. A laboratory demonstrator will also sign your lab. book after this assessment. Your notes, experimental results, graphs produced using these results and your explanation of these will be examined by the demonstrators at the end of each laboratory period. You may also be required to submit detailed reports on some of the experiments in due course. The format of this will be announced later.

Tutorials:

The tutorial for this course will start in Week 2. Tutorial sheets can be downloaded from the Lecture Notes website. Solutions of tutorial problems will be available from the Lecture Notes website progressively, shortly after the problems are discussed in the tutorial class.