ECE3051

Electrical energy systems/ Electrical power engineering

Unit Guide - on campus

Second Semester, 2007
ECE3051 Electrical energy systems/ Electrical power engineering Unit Outline
Faculty of Engineering

ECE3051 Electrical energy systems/ Electrical power engineering

Unit Guide – on campus

Second Semester, 2007

Unit staff – contact details

<table>
<thead>
<tr>
<th>Unit Coordinator:</th>
<th>Assoc. Prof. Donald Holmes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Campus:</td>
<td>Clayton</td>
</tr>
<tr>
<td>Room:</td>
<td>G04/69</td>
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<tr>
<td>Email:</td>
<td><a href="mailto:Grahame.Holmes@eng.monash.edu.au">Grahame.Holmes@eng.monash.edu.au</a></td>
</tr>
<tr>
<td>Office hours:</td>
<td>Tuesday 2 – 5 pm</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Other academics:</th>
<th>Dr. Tadeusz Czaszejko</th>
</tr>
</thead>
<tbody>
<tr>
<td>Campus:</td>
<td>Clayton</td>
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<td>Room:</td>
<td>G17B/35</td>
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<tr>
<td>Email:</td>
<td><a href="mailto:Tadeusz.Czaszejko@eng.monash.edu.au">Tadeusz.Czaszejko@eng.monash.edu.au</a></td>
</tr>
</tbody>
</table>
Contents

Unit staff – contact details ................................................................. 3

Unit Outline ................................................................................. 1
  Unit synopsis ............................................................................... 1
  Engineers Australia generic attributes ......................................... 1
  Workload ..................................................................................... 2
  Unit relationships ......................................................................... 2
  Continuous improvement ............................................................. 3

Teaching and Learning Method ...................................................... 3
  Communication, participation and feedback ................................. 3
  Unit schedule ............................................................................... 4

Unit Resources .............................................................................. 5
  Prescribed texts .......................................................................... 5
  Recommended texts ...................................................................... 5
  Reading ........................................................................................ 5
  Required software (and/or hardware) (optional) .............................. 6
  Equipment and consumables required or provided (optional) ........... 6
  Study resources .......................................................................... 6
  Monash University Studies Online (MUSO) ...................................... 6

Assessment .................................................................................... 7
  Assessment tasks ......................................................................... 7
  Assessment details and criteria ..................................................... 7
  Hard copy assignment submissions ............................................... 9
  Electronic submission of assignments in MUSO ............................... 9
  Instructions for submitting an assignment electronically using MUSO .................................................. 10
  Assignment coversheet ................................................................ 11
Unit Outline

Electrical Grids - Single phase and three phase AC networks; per unit system; power factor and power factor correction; electrical energy conversion; structure of electrical power networks; electric power generation, power transmission; distributed generation technologies; distribution of electrical power systems; transmission line modelling, transmission line parameters; power line harmonics and quality of electrical power supply; protection of electrical plant and power systems; three phase power transformers

Electrical Energy conversion – Single phase and three phase SCR rectifiers, effects of source and load inductance; DC-AC switched converters and modulation strategies; applications to variable speed DC and AC motor control; principles of vector control for AC machines; switched converter applications for uninterruptible power

Electrical machines - Electrical machines; analysis and modelling of DC machines, theory and performance of three-phase induction motors, single phase induction motors, synchronous machines, brushless DC machines; real and reactive power flow through synchronous machines, connection to an infinite bus; reluctance motors, stepper motors; fixed and variable speed motor operation, open and closed loop motor drive systems

Unit synopsis

The unit begins by considering electrical machines, looking at DC machines, induction motors, synchronous motors and other types of motors under fixed and variable speed operation. Then thyristor rectifiers and switched power converters are presented, looking at their use for electrical energy conversion in general and variable speed motor control in particular. Finally, single and three phase AC networks, power factor correction, and electrical power generation, transmission and distribution networks are explored. Particular focus is given here to three phase transformers, transmission line modelling, quality of electrical supply, electrical protection systems, and power system control.

Engineers Australia generic attributes

The Engineers Australia Policy on Accreditation of Professional Engineering Programs – requires that all programs ensure that their engineering graduates develop to a substantial degree the generic attributes listed below. Listed below are the activities in this unit that will help you to achieve these attributes.

Note: that not all graduate attributes are relevant to each unit.

<table>
<thead>
<tr>
<th>Generic Attribute</th>
<th>Activities used in this Unit to Develop Generic Attributes</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) ability to apply knowledge of basic science and engineering fundamentals;</td>
<td>Lectures, problem sheets</td>
</tr>
<tr>
<td>b) ability to communicate effectively, not only with engineers but also with the</td>
<td>Laboratory sessions</td>
</tr>
</tbody>
</table>

Page 1
c) in-depth technical competence in at least one engineering discipline;  
Problem sheets, laboratory sessions

d) ability to undertake problem identification, formulation and solution;  
Laboratory sessions

e) ability to utilise a systems approach to design and operational performance;  
Not relevant

f) ability to function effectively as an individual and in multi-disciplinary and multi-cultural teams, with the capacity to be a leader or manager as well as an effective team member;  
Laboratory sessions

g) understanding of the social, cultural, global and environmental responsibilities of the professional engineer, and the need for sustainable development;  
lectures

h) understanding of the principles of sustainable design and development;  
lectures

i) understanding of professional and ethical responsibilities and commitment to them; and  
lectures

j) expectation of the need to undertake lifelong learning, and capacity to do so.  
lectures, laboratory sessions

### Workload

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Lectures</td>
<td>3 hours</td>
</tr>
<tr>
<td>Laboratory</td>
<td>3 hours</td>
</tr>
<tr>
<td>Tutorial</td>
<td>0 hours</td>
</tr>
<tr>
<td>Private study</td>
<td>6 hours (consisting of individual and group assignment work, lecture revision, and additional researching and reading)</td>
</tr>
<tr>
<td>Total per week</td>
<td>12 hours</td>
</tr>
</tbody>
</table>

All laboratory classes are compulsory, even for repeating students.

### Unit relationships

<table>
<thead>
<tr>
<th>Prerequisites</th>
<th>ECE2021, ECE2062, ENG1030</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corequisites</td>
<td>None</td>
</tr>
<tr>
<td>Prohibitions</td>
<td>ECE3502</td>
</tr>
</tbody>
</table>
Continuous improvement

Monash is committed to ‘Excellence in education’ and strives for the highest possible quality in teaching and learning. To monitor how successful we are in providing quality teaching and learning Monash regularly seeks feedback from students, employers and staff. One of the key formal ways students have to provide feedback is through Unit Evaluation Surveys. It is Monash policy for every unit offered to be evaluated each year. Students are strongly encouraged to complete the surveys as they are an important avenue for students to “have their say”. The feedback is anonymous and provides the Faculty with evidence of aspects that students are satisfied and areas for improvement.

Faculties have the option of administering the Unit Evaluation survey online through the my.monash portal or in class. Lecturers will inform students of the method being used for this unit towards the end of the semester.

Previous Student Evaluations of this unit
If you wish to view how previous students rated this unit, please go to http://www.monash.edu.au/unit-evaluation-reports/

Over the past few years the Faculty of Engineering has made a number of improvements to its units as a result of unit evaluation feedback. Some of these benefits include tutor/demonstrator training, improved objectives and better feedback mechanisms.

Immediate feedback for us
Feedback is welcome at any time throughout the semester. Please use email to send it to the unit co-ordinator, or in person.

You may wish to use the open ended questions in the unit evaluation to provide written feedback on your experience of this and whether it has been helpful to you during this semester.

Teaching and Learning Methods

Laboratories will be of 4 hours duration, eight weeks only during semester.

Solution of problem sheets will be posted onto the website. Worked solutions will be posted approximately 1-2 weeks after each problem sheet is posted.

Communication, participation and feedback

Monash aims to provide a learning environment in which students receive a range of ongoing feedback throughout their studies. In this unit it will take the form of group feedback via practice classes, individual feedback, peer feedback, self-comparison, verbal and written feedback, discussions in class, as well as more formal feedback related to assignment marks and grades. Students are encouraged to draw on a variety of feedback to enhance their learning.
## Unit schedule

<table>
<thead>
<tr>
<th>Week</th>
<th>Lecture</th>
<th>Tutorial</th>
<th>Lab</th>
<th>Assignment activity</th>
</tr>
</thead>
</table>
| 1    | 1. Single phase AC networks  
2-3. Three phase AC networks; per unit system; power factor and power factor correction | . AC Networks  
. Boost Converter  
. H Bridge/PWM | . AC Networks  
. Boost Converter  
. H Bridge/PWM |
| 2    | 4. Buck and Boost converters, consolidation to a two switch phase leg  
5-6. Single and Three Phase VSI switched converters, modulation strategies, PWM, operating conditions into various load types | . AC Networks  
. Boost Converter  
. H Bridge/PWM | . AC Networks  
. Boost Converter  
. H Bridge/PWM |
| 3    | 7. Review magnetic field theory, principle of three phase rotating magnetic field  
8-9. Synchronous machines, theory and standalone operation | . AC Networks  
. Boost Converter  
. H Bridge/PWM | . AC Networks  
. Boost Converter  
. H Bridge/PWM |
| 4    | 10. Synchronous machines, operation into an infinite grid connection  
11. Synchronous machines, operation into an infinite grid connection  
12. Review single phase transformers, magnetising current harmonic distortion | . Sync Machines  
. Boost Converter  
. H Bridge/PWM | . Sync Machines  
. Boost Converter  
. H Bridge/PWM |
| 5    | 13. Three phase transformers, winding interconnection alternatives, neutral oscillation  
14-15. Electrical energy conversion; structure of electrical power networks; electric power generation; electrical power transmission | . Sync Machines  
. Boost Converter  
. H Bridge/PWM | . Sync Machines  
. Boost Converter  
. H Bridge/PWM |
| 6    | 16-17-18. DC Motors | . Sync Machines  
. Boost Converter  
. H Bridge/PWM | . Sync Machines  
. Boost Converter  
. H Bridge/PWM |
| 7    | 19. Single phase SCR converters  
20-21. Three phase SCR converters, effects of source and load inductance, rectification and inversion | . DC Machines  
. One Phase SCR  
. Three Phase SCR | . DC Machines  
. One Phase SCR  
. Three Phase SCR |
| 8    | 22. mid semester test  
23. Three phase SCR | . DC Machines  
. One Phase | . DC Machines  
. One Phase |
<table>
<thead>
<tr>
<th>Unit Resources</th>
<th>Prescribed texts</th>
<th>Recommended texts</th>
</tr>
</thead>
</table>

**Prescribed texts**


**Recommended texts**

Further reading to be advised during the semester as required.
Required software (and/or hardware) (optional)

Equipment and consumables required or provided (optional)

Study resources
Library, MUSO website, departmental unit website

Monash University Studies Online (MUSO)
All unit and lecture materials are available through the MUSO (Monash University Studies Online) site. You can access this site by going to:

a)  http://muso.monash.edu.au or
b) via the portal (http://my.monash.edu.au).

Click on the My Units tab, then the Monash University Studies Online hyperlink

In order for your MUSO unit(s) to function correctly, certain programs may need to be installed such as Java version 1.4.2. This can easily be done by going to http://www.monash.edu.au/muso/support/students/downloadables-student.html to update the relevant software.

You can contact the MUSO helpdesk by:

Phone  (+61 3) 9903-1268 or 9903-2764

Operational hours (Monday – Thursday) – local time
Australia:  8 am to 10 pm (8pm Non Teaching period)
Malaysia:  6 am to 8 pm (6 pm Non Teaching period)

Operational hours (Friday) – local time
Australia:  8 am to 8 pm
Malaysia:  6 am to 6 pm

Operational hours (Saturday-Sunday) – local time (Teaching and Exam Period Only)
Australia:  1 pm to 5 pm
Malaysia:  11 am to 3 pm

Further information can be obtained from the following site
Assessment

Assessment tasks

Examination: (3 hrs), 70%. Continuous assessment: 30%. Students must achieve a mark of 45% in each of these components and an overall mark of 50% to achieve an overall pass grade.

The unit coordinator reserves the right to moderate the assessments given by the individual tutors. This process will occur at the end of the semester.

<table>
<thead>
<tr>
<th>Week</th>
<th>Submission Date</th>
<th>Activity</th>
<th>Value %</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Thursday 11am-2pm</td>
<td>Laboratory briefing (30 minute sessions as scheduled)</td>
<td>req’d</td>
</tr>
<tr>
<td>1-12</td>
<td>Friday of each week as scheduled</td>
<td>Laboratory experiments</td>
<td>20</td>
</tr>
<tr>
<td>8</td>
<td>Lecture, 3 Sept 2007</td>
<td>Mid-Semester Test</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Total continuous assessment</td>
<td>30</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Exam (3 hours)</td>
<td>70</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Total assessment</td>
<td>100%</td>
</tr>
</tbody>
</table>

Assessment details and criteria

Assessment Task 1:
Laboratory Briefing
(30 minute sessions as scheduled)

Details of task: This session is compulsory.
30 minute laboratory safety and equipment briefing, scheduled in week 1 on Thursday 19 July, 11am to 2 pm. Students will be allocated to a briefing session in week #1.

Criteria for Assessment task 1:
Attendance at the laboratory safety and briefing session is a mandatory requirement before students will be allowed to undertake laboratory work. Students who have not attended a briefing session will be unable to complete the laboratory work, and will therefore not be able to pass the continuous assessment component of the unit.

Assessment Task 2:
Laboratory experiments.
Details of task: Each student will do eight 4 hour experiments, scheduled throughout the semester. Students will work in groups of 2.
Laboratory sessions are 4 hours, arranged as an initial briefing session (up to 1 hour depending on the experiment) and a 3 hour laboratory session following on directly.
Each laboratory will be marked out of 10, scored as 3 marks for preliminary submission, 4 marks for laboratory achievement, 3 marks for quality and presentation of recorded experimental results.

**Criteria for Assessment task 2:**
- Preliminary work will be marked during the initial briefing session for each laboratory. Marks will be based on correctness of results. Preliminary work must be submitted by EACH student at the start of the laboratory session – late submissions will not be considered – and marks will be given on an individual student basis.
- Laboratory achievement will be assessed by demonstrators at the end of the laboratory, and will be based on level of student preparedness, level of completion of experimental work and general level of competency and understanding shown during the laboratory session. Students will be marked as a group of 2 for this part of the assessment.
- Laboratory record assessment will be based on completeness of procedure and results recorded during the laboratory session, and level of understanding reflected in any comments recorded as part of the experimental work. This assessment will be made at the end of each laboratory session. Students will be marked as a group of 2 for this part of the assessment, and results need be entered in only one laboratory record book for each group for each experiment. Failure of a group to bring and use a laboratory record book will be given an automatic zero for this section of the laboratory assessment.

Laboratory marks will be averaged at the end of the semester to make 20% of the overall assessment.

**Assessment Task 3:**

Mid-Semester Test

**Details of task:** Test will have a duration of one hour, and will be held during the scheduled lecture time, 3 September, 8am - 9am. Location will be the scheduled lecture theatre. Test will comprise up to 4 questions, based on material covered in lectures to the test date.

**Criteria for Assessment task 3:**
Test will be marked out of 40 (10 marks per questions), and scaled appropriately to make a final contribution of 10% of the overall assessment

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**Plagiarism**

Plagiarism involves passing off as your own, work that is not your own.

This comes in three main forms.

1. **Copying another student’s work** - Just don't do it!

2. **Collaborating with another student on work required to be done individually.**
   - Before working collaboratively, make sure that you are allowed to collaborate and only collaborate to the extent allowed.

3. **Copying material from other sources, including web sites, without adequate acknowledgement.**
   - Any quote of a complete sentence or longer MUST be enclosed in quotation marks, and immediately followed by the reference. In general, quotations of more than a few sentences should not be used. Students should digest the information and then write...
about it in their own words. A reference to the source of the ideas must still be included.

- Any copied image must be acknowledged in the figure legend. Modified figures must be acknowledged as “modified from......”.

- Copying material from the web is a growing problem. Fortunately the same search engines that allow students to find information are also very good at allowing markers to detect copied submissions.

Plagiarism will not be tolerated. Any assignment clearly showing plagiarism will be immediately disallowed, ie awarded zero marks. First offences may, and multiple offences will, lead to disciplinary action.

Hard copy assignment submissions

All students are required to maintain a bound laboratory book, into which records of the experimental work must be written during the laboratory sessions. The laboratory record assessments will be marked only on what is written in this book – loose leaf laboratory records will not be marked.

Students: You must keep a copy of your assignment in electronic format. We suggest you keep a print out also.

Electronic submission of assignments in MUSO

How it works

1. If Electronic Submission has been approved for your unit, use only the MUSO assignment submit tool. Do not submit files attached to email. Log into MUSO http://muso.monash.edu.au and select the unit for which you wish to submit work.

2. Unless you have made prior arrangement s with your lecturer, only the following file formats will be accepted: .doc, .rtf, .txt, .pdf, .html

3. It is essential you adhere to the following format for the naming of the file you wish to submit:
   a) It MUST contain your Authcate name.
   b) There must be NO SPACES in the filename.

4. You will receive a confirmation message within MUSO once you have successfully submitted your assignment within the electronic dropbox.

5. Comments and grading of your assessment will be communicated to you either by MUSO, email, or post.
Instructions for submitting an assignment electronically using MUSO

1. Click on the Assignments icon on the relevant unit homepage. The Assignments screen displays.

2. Click on the assignment title for which you wish to submit your work.

3. Click on the Add Attachments button.

4. To locate your file, click on the Upload File button. The Upload File menu will appear.

5. Locate the assignment file you wish to upload by clicking on the Browse button.

6. Select the file and click on the Open button. The Upload File for Assignment screen appears with your uploaded file displayed.

7. Click on the Save button.

8. You will see a green tick next to your uploaded file. To confirm this is the file you wish to upload, click the Add Selected button.

9. Click on the Submit button. You'll see a confirmation window when your assignment has been successfully submitted.

10. To return to the MUSO homepage, click on the Continue button.

The rules
By submitting your assignment electronically you are deemed to have accepted these rules.

1. Late assignments will not be accepted electronically as the mailbox will be disabled at 5.00pm on the due date.

2. You must keep a copy of your assignment in electronic format. We suggest you keep a print out also.

3. The cover page of your assignment must set out your name, student number, topic, tutor's name and a declaration that says "I [insert your name] declare that this assignment is entirely my own work and that it has not been submitted for assessment in any other unit. I have kept a copy of this assignment. This project contains no material that has been accepted for the award of any other degree or diploma in any educational institution and, to the best of my knowledge and belief, it contains no material previously published or written by another person, except where due reference is made in the text of the project."

4. Remember that, just as for hard copy submissions, you should arrange your study /workload so as to allow plenty of time for last minute hitches. Computer problems/ busy servers will NOT be an excuse for an extension. Do not leave electronic submission of your assignment to the last minute.
Assignment coversheet

All assignments need to be submitted with a signed coversheet.

The coversheet is accessible on the departmental web site at: http://www.ecse.monash.edu.au/teaching/covr_sht.doc