



School of Electrical Engineering & Telecommunications

Faculty of Engineering

GSOE9742

# **Energy Efficient Lighting and Equipment**

Summer Session, 2015-2016

# GSOE9742

## COURSE INTRODUCTION – Summer Session, 2015

### Course staff

Course convener: A/Prof Trevor Blackburn, Material Science Engineering Building Room 743A, Ph. 9385 4049, email: [t.blackburn@unsw.edu.au](mailto:t.blackburn@unsw.edu.au)

### Course details

#### Credits (UOC)

Course GSOE9742 is 6 UOC with an expected average workload of approximately 15 hours per week during session.

#### Contact Hours:

The summer session officially runs over two periods, Period A from 30/11/15-16/12/15, and Period B from 4/01/16-15/02/16. The class schedule comprises a series of 12 3-hour lecture blocks, at times and dates shown below.

#### Consultations:

Your course convener will be your main source of assistance for the course, and he will advise the consultation arrangements for the course. Any and ALL email enquiries should be made from your student email address with GSOE9742 in the subject line, otherwise they will not be answered.

### Course Information

#### Context and aims

Electrical Energy efficiency in all of the various forms of electrical energy usage is a topic of considerable current importance and almost all developed countries have enacted some forms over legislation involving mandated efficiency levels for electrical equipment and appliances.

This course provides a detailed coverage of electrical energy efficiency and the various ways in which efficiency measures have been imposed. The course is in three parts, as outlined below.

#### Pre-requisites and assumed knowledge:

There are no formal pre-requisites for this course, however it is assumed that students have knowledge effectively equivalent to about second year electrical engineering, with electromagnetic theory and (three phase) circuit theory and a rudimentary knowledge of transformer and motor principles. Please contact the course convener early for advice if your previous study has not covered all of these topics.

#### Learning Outcomes (LO)

After successful completion of this course, you should be able to

1. Demonstrate a basic understanding of electrical losses in equipment.
2. Discuss and analyse different kinds of lighting and the electrical efficiency of electrical items used in producing, controlling and distributing light.
3. Understand and explain the implications of the regulatory aspects of electrical efficiency.

## **Draft Lecture schedule:**

### **1 Electrical losses in equipment (6 sessions)**

All standard electrical equipment and appliance operation involves some loss generation in the variation component parts. This includes direct galvanic loss, induced loss such as eddy currents in conducting materials, dielectric loss in insulating materials, electrical discharge loss caused by ionization and stray loss induced in materials in the general vicinity of, but not part of, electrical equipment or appliances.

This section outlines the various types of losses and how they manifest themselves in equipment and appliances. A number of items of equipment will be analysed, including transformers, rotating machines, cables, switchgear etc. The impact of these losses on the insulation lifetime will also be discussed and analysed, together with a discussion of the ways in which such losses can be reduced, with improvement in efficiency and in insulation longevity.

The use of power electronic controllers for appliances and equipment is now becoming almost ubiquitous but one of the problems associated with such items is the generation of very significant harmonic content (and in some cases of switching overvoltages) which acts to increase losses substantially. In many cases this may require the reduction of the operational rating below the nameplate rating of the equipment to maintain operational temperatures within tolerable limits. The impact of such harmonics and of reduced power quality in general will be discussed. Most information technology equipment, including personal computers, with switch-mode power supplies also fall into this category.

The efficiency of the use of DC distribution systems in buildings with large densities of IT systems will be analysed with a comparison of the efficiencies that are available compared with the use of the standard AC distribution system.

### **2 Electrical lighting efficiencies (3 sessions)**

Lighting is one of the major uses of electrical energy (typically up to 20% in developed countries) and is thus a prime candidate for efficiency measures, both in the luminaire design and in the lamps and in the control equipment used for discharge stabilization and for light dimming purposes. Modern lighting has been revolutionized in recent years by the banning of the incandescent lamp and by the increase in the use of light emitting diode (LED) and the compact fluorescent lamp (CFL) which have been able to be developed in their efficiency and in their general spectral range output.

In addition to LEDs and CFLs there have been major developments in other light sources that have allowed great improvements in lighting electrical efficiency. These include metal halide lamps, general high intensity discharge lamps and plasma induction lamps.

The lighting section will cover the various types of light sources and the ways in which the light is produced and in particular in the electrical efficiency of the electrical items that are used in producing, controlling and distributing the light output. The design of efficient luminaires (the housings of the lamps) is a particular issue for efficiency of application in lighting.

### **3 Regulatory aspects of electrical efficiency (2 sessions)**

Most developed countries now have parliamentary regulation of the efficiency of the majority of the most common items of electrical equipment and appliances. In Australia this is governed by the MEPS (minimum energy performance standards) program or more recently designated GEMS (greenhouse and energy minimum standards). Minimum electrical efficiency levels are mandated for equipment (for example, motors, air conditioners, lamp ballasts, transformers etc) and the various items have to be tested for compliance with the efficiency levels before they can be sold in Australia.

This section of the course will describe the general MEPS and GEMS approach and outline how Australian efficiency levels compare with those of other countries, including Japan, USA and Europe. The applicable standards will be discussed critically and the test methods used for energy efficiency determinations will be described and discussed.

## Class Schedule

Date	Time	Location
1-Dec-15	18-21	EEG24
3-Dec-15	18-21	EEG24
8-Dec-15	18-21	EEG24
10-Dec-15	18-21	EEG24
5-Jan-16	18-21	EEG24
7-Jan-16	18-21	EEG24
12-Jan-16	18-21	EEG24
14-Jan-16	18-21	EEG24
19-Jan-16	18-21	EEG24
21-Jan-16	18-21	EEG24
28-Jan-16	18-21	EEG24
2-Feb-16	18-21	EEG24

### FINAL EXAM

14-Feb-16 8:45 EE418

## Assessment

The assessment will be by means of two assignment projects done during the course (40%) and a final open-book examination (60%) of the mark.

PLEASE NOTE: Summer session courses do not allow any possibility for supplementary assessment. Please plan to pass this course outright.

## Course Resources

The course will follow reasonably closely the following book:

Electrical Energy Efficiency - Technologies and Applications  
by A Sumper and A Baggini  
John Wiley UK, 2012  
ISBN 9780470975510

## 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:

<http://www.lc.unsw.edu.au/plagiarism>

### Continual Course Improvement

Students are advised that 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 and/or via the Course and Teaching Evaluation and Improvement Process.

### 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: <http://scoff.ee.unsw.edu.au>.

Guidelines on learning that inform teaching at UNSW are available at [www.guidelinesonlearning.unsw.edu.au](http://www.guidelinesonlearning.unsw.edu.au).