1 Course Introduction

1.1 Course Facilitator

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1.2 Credits

This is a 6 UoC course and the expected workload is approximately 7-8 hours per week throughout the 13-week semester.

1.3 Contact hours

There will be three face-to-face workshops which students will be required to attend as part of the course on the following dates:

- Week 1: 3 March 2014, 9am-12pm, Venue: Red Centre, Room 4037
- Week 6: 7 April 2014, 9am-12pm, Venue: Red Centre, Room 4037
- Week 10: 12 May 2014, 9am-12pm, Venue: Red Centre, Room 4037

The facilitator is happy to discuss any issues or matters related to the course every day of the week as long as a convenient meeting time has been set at least one day ahead. Please e-mail the course facilitator with any requests.
2 Course Information

2.1 Course Rationale

This course will offer flexible delivery, being conducted in blended mode combining three face-to-face workshops, online activities and workplace-based learning (if applicable). The course can be taken to contribute towards an Engineering Masters program (as 6 Units of Credit), or be taken as non-Award (without academic assessment), contributing instead towards Continuing Professional Development (CPD).

Implementation of Smart Grid strategies by power utilities necessitates a new set of skills, experiences and knowledge. Understanding the Smart Grid requires knowledge of numerous key engineering topics in electrical and power engineering, telecommunications and information technologies. Such key engineering disciplines also must intersect other disciplines including sciences, markets, business strategies and processes, energy related policies and regulation. The Smart Grid requires a suite of new standards to be developed and implemented from the technical point of view. Moreover, the Smart Grid is a customer-centred transformation of aged electricity grids and promises to deliver many benefits to customers, hence consumer behaviour and social sciences also play an important role in smart grids.

Professionals and engineers working in the power industry and information and communications technologies will seek to upgrade and expand their practical skills to meet unprecedented market demand. This course provides a cross-disciplinary overview approach of the various topics of a Smart Grid ranging from the fundamentals of Smart Grids to renewable energy systems, energy storage, IT communications and standards. The course focuses mainly on intelligent electricity distribution networks and provides the basis for the new thinking and design methodology required by engineers and professionals for transforming the current distribution networks to become a major part of the future intelligent electricity network.

2.2 Handbook Description

A Smart Grid is the integration of numerous technologies, systems and processes with the aim to modernise and fully automate the entire electricity grid covering generation, transmission, distribution, utilisation plus conservation of energy. Smart grids will revolutionise the design, development, management, operation and maintenance of the grid to levels that were thought impossible some decades ago. The driving force behind Smart Grids include environmental awareness of people and governments; the need for further automation and energy efficiency; large capital investments for the renewal of the ageing infrastructure in most developed countries including Australia; adoption of competitive energy prices; security of supply; energy conservation and the ever increasing electricity demand that needs to be met. The course will provide advanced information and thinking required by engineers and professionals to deliver Smart Grid concepts from inception to implementation. The course will mainly focus on intelligent electricity distribution networks, present the latest technologies used to automated such networks and analyse the impact of these technologies on system design, operation, management and maintenance.

2.3 Course Aims

The aims of the course are to:

- Present the fundamental concepts associated with Smart Grids.
- Review renewable energy generation, grid integration energy storage technologies and future developments
- Introduce advanced management and control concepts of Smart Grids.
- Construe the data management requirements and ICT technologies for Smart Grids.
• Present standards related to the development of smart grids, identify key stakeholders and potential impact.

2.4 Learning Outcomes

At the conclusion of the course students should be able to:

• LO1: Identify the key elements of Smart Grids and visualise the roadmap towards next-Gen electricity networks.
• LO2: Evaluate technology options pertaining to renewable energy generation, energy storage, data handling and communications for Smart Grids.
• LO3: Justify technological and economical choices in the context of existing commercial Smart Grids projects and suggest improvements and expansions.
• LO4: Determine the relevance of Smart Grids projects, develop ways to evaluate their impacts and implications.
• LO5: Analyse the new roles of utilities and consumers in Smart Grids and pinpoint business and market opportunities and potential gains.

3 Course Content

3.1 Syllabus

Smart grids; Intelligent Distribution Networks; Renewable Energy; Distributed Generation; DG Integration; Solar; Wind; Energy Storage Technologies; Chemical, Mechanical and Electrical Energy Storage; Demand Side Management; Load Management; Demand Side Response; Conservation Voltage Reduction; Demand Pricing; Time of Use; Real Time Pricing; Peak Time Pricing; FDIR; Reactive Power Optimisation; Volt-Var Optimisation; Distribution Automation; Advanced Asset Management; Electric Vehicles; Smart Meters; Advanced Measuring Infrastructure; Distribution Management Systems; Smart Grid ICT; Common Information Model; Cyber-Security; Wide Area Measurement Systems; Smart Grid Communications; SCADA; SG costs; Markets; Ancillary Markets; Smart Grid Standards; Substation Automation; Stakeholders and Benefits;

3.2 Lecture Topics

Lecture 1:  Introduction to Smart Grids and Intelligent Distribution Networks
Lecture 2:  Renewable Energy Integration in Smart Grids
Lecture 3:  Energy Storage Technologies
Lecture 4:  Demand Side Management, Demand Response and Demand Pricing
Lecture 5:  FDIR and Volt-Var Optimization - Asset Health Management
Lecture 6:  Smart Meters - Electric Vehicles In Smart Grids
Lecture 7:  IT Networks and Security
Lecture 8:  Telecommunication Systems in Smart Grids
Lecture 9:  Economics of Smart Grids
Lecture 10: Smart Grid Standards
Lecture 11: Impact, Policies, Demonstration Projects, Stakeholders and the way forward
Lecture 12: Review of the Smart Grid - Smart City Project

3.3 Teaching Strategies

You are expected to attend the three face-to-face lectures of the course. The facilitator will discuss assessment and assignment criteria and comment on current assessment tasks and marks during these three sessions.

The material of the course will be provided on-line through UNSW’s Moodle page, https://moodle.telt.unsw.edu.au/login/index.php. The students are expected to follow the material of the course as it is weekly updated on the website but they are free to study on their own pace.

Additional video resources will be also linked. These resources have been selected as they provide valuable insights from industrial meetings and forums, enhance the coverage of the material and should be considered as content of the course. You can view these resources at your own time as well.

The rationale behind these methods of delivery for the course is that the Smart Grid is a complex collection of different technologies and the course offers a “bird’s eye” view of the core components. The course is not designed to be a power system analysis or telecommunication course but provides the students with the knowledge and the resources in order to identify and tackle the requirements in the current transformation of the electricity networks.

4 Course Activities and Assessment

4.1 Pre-requisites to pass the course

In order to receive a passing mark for the course, submission and participation in all summative assessment and an overall passing mark of 50/100 is required.

4.2 Assessment Activities

The course does not include a final exam and all assessment (formative and summative) will take place throughout the semester. The assessment tasks include:

- ASMT1: Week 1 to week 12 brief assignment (1 page maximum) (5 marks)
- ASMT2: 5 bi-weekly reports which include brief literature reviews or research related to the topics discussed in the course. The bi-weekly reports are due by the end of week 3, week 5, week 7, week 9 and week 11 (5 x 8 marks = 40 marks)
- ASMT3: Contribution to the discussion in the forums. A number of topics will be offered throughout the course for discussion and 2 of them – one selected by the student and one randomly selected will be used for the summative assessment (2 x 7.5 marks = 15 marks)
- ASMT4: Multiple choice tests (2 x 7.5 marks = 15 marks)
- ASMT5: A report on an existing smart grid project (written report and presentation) due by the end of week 13 (17+8 marks= 25 marks)
- Contribution to the course Wiki - developing brief definitions of different smart grid related concepts (up to 5 bonus marks available)
4.3 Assessment methods vs. Learning Outcomes

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4.4 Submission of Assessment Tasks

Assessment tasks will be submitted via the Moodle page of the course. Each assessment task will have two deadlines, a soft deadline for the submission of each assignment after which submissions will incur a 10% penalty per day of delayed submission. The soft deadline will be followed by a hard deadline three days later, after which no marks will be given to an assignment. Submission of an assignment past the hard deadline will be accepted via email.

Marking of the assessments will be based on a detailed rubric that will be made available in Moodle during the first week of the semester and explained in detail at the first face-to-face session of the course in week 1.

4.5 Student Thesis and Projects

If a student is interested in working on a Smart Grid related project as his thesis project, he can contact the course facilitator to arrange a meeting and discuss topics, workload and necessary support. Also refer to available student projects from the School of EE&T at [http://www.engineering.unsw.edu.au/electrical-engineering/4th-year-thesis](http://www.engineering.unsw.edu.au/electrical-engineering/4th-year-thesis)

5 Textbook

No textbook is required for the course and the presentations – notes include material from a wide range of sources that cover the different aspects of the Smart Grid. References to related books and supplementary reading and video material will be provided when deemed necessary. Major references of the subject include the

- IEEE Transactions on Smart Grid
- IEEE Innovative Smart Grid Technologies Conference (ISGT) family of conferences

5.1 Additional References

Links to supplementary resources and material will be given each week at the course’s Moodle website. Some references related to the subject are the following:

- The Smart Grid: An Introduction, Department of Energy (US)
- Towards Smart Power Networks – Lessons learned from European Research Framework Program 5 Projects, European Union
6 Other Matters

6.1 Academic Honesty and Plagiarism

Plagiarism is the unacknowledged use of other people’s work, including the copying of assignment work 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, or discuss any questions you have with the lecture staff.

6.2 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 on the course to the course instructors.

All courses within the School are subject to a course evaluation towards the end of session. 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).

6.3 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 web-site, see http://www.ee.unsw.edu.au/.

6.4 Graduate Attributes – UNSW

UNSW aspires to develop graduates who are rigorous scholars, capable of leadership and professional practice in a global community (B2B, p.7). The university has, thus, articulated the Graduate Attributes (see title hyperlink) as desired learning outcomes for ALL UNSW students.

6.5 Graduate Attributes – Faculty of Engineering

The University Graduate Attributes which have been approved by Academic Board require extensions to make them applicable to each Faculty. Suggested expansion of each attribute, using Engineering requirements. The full set of engineering graduate attributes are given in the title link.