Subject Description Form

Subject Code	EE570
Subject Title	Design and Analysis of Smart Grids
Credit Value	3
Level	5
Pre-requisite / Co-requisite/ Exclusion	Nil
Objectives	1. To provide students with a comprehensive understanding on design and analysis of smart grids; 2. To ensure the students aware of the current state-of-the-art on design, operation and control of smart grid; 3. To acquire knowledge on the components in smart grids and their functions; and 4. To enable students to apply advanced analysis tools in planning and operation of smart grids.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. Acquire in-depth understanding on recent development of power grids, i.e. smart grid; b. Apply advanced analysis tools in planning and operation of smart grids; and c. Acquire skills in presentation and interpretation of results in written form.
Subject Synopsis/ Indicative Syllabus	1. ***Introduction to smart grid*****:** Overview of power system operation; Comparison between existing grid and smart grid; Objectives; Benefits; Challenges; Basic structure and functions of components. 2. ***Communications and measurement*****:** Latest technologies; Wide Area Monitoring Systems (WAMS), Phasor Measurement Units (PMU), Smart Meters, Smart Appliances, and Advanced Metering Infrastructure (AMI); GIS and Google Mapping Tools; Multiagent Systems Technology. 3. ***Micro-grid*****:** Concept of micro-grid; design and analysis; distributed generation; distributed automation. 4. ***Renewable energy and storage*****:** Renewable energy resources and options for smart grid including solar energy, wind energy, fuel cell, biomass etc.; Penetration and variability; Demand Response; Electric vehicles and plug-in hybrid; Battery energy storage systems. 5. ***Interoperability, standards and cyber security:*** State-of-the-art, Benefits, Challenges, Risks. 6. ***Analysis tools*****:** Power/load flow studies; Static security assessment; State estimation and stability assessment; Reliability assessment; Decision support tools; Advanced optimization and control; Environmental impacts; Pathway for designing smart grid. 7. ***Standards and critical infrastructure protection:*** State-of-the-art, Benefits, Challenges, Risks.

Teaching/Learning Methodology

Lectures and tutorials are the primary means of conveying the concepts and theories. Mini-projects are designed to supplement the lecturing materials so that the students are encouraged to take extra readings and the latest development of the smart grids.

Teaching/Learning Methodology	Outcome		
	a	b	c
Lectures	✓	✓	
Tutorials		✓	✓
Mini-project		✓	✓

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed		
		a	b	c
1. Examination	63%	✓	✓	
2. Class test	18%	✓	✓	
3. Mini-project	19%		✓	✓
Total	100%			

Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes:

The outcomes on understanding on development of smart grid and application of advanced analysis tools are assessed by the usual means of examination and tests. Mini-projects and written reports assess those on analytical skills, problem-solving techniques and technical reporting.

Student Study Effort Expected

Class contact:	
▪ Lectures	36 Hrs.
▪ Tutorial	3 Hrs.
Other student study effort:	
▪ Self-study	50 Hrs.
▪ Mini-project	16 Hrs.
Total student study effort	105 Hrs.

Reading List and References

1. P. Sioshansi, “Smart Grid: Integrating Renewable, Distributed & Efficient Energy,” Elsevier Inc., 2012.
2. J.A. Momoh, “Smart Grid: Fundamentals of Design and Analysis,” 2012 IEEE, John Wiley & Sons, Inc., 2012.
3. Peter Fox-Penner, “Smart Power: Climate Change, the Smart Grid, and the Future of Electric Utilities,” Island Press, 2010.