Course no.:	ENR 128
Course title:	**Smart Grids**
Core or elective:	Elective
Number of credits:	3
Number of lectures-tutorials-practicals:	36-4-2
Course coordinator:	Mr C N Raghupathy

Course Objectives:

This course seeks to provide an understanding of why Smart Grids are critical to the sustainability and growth of India's electricity network, and what technologies as well as business and commercial frameworks are available/will be available, to enable a shift from today's situation to the intelligent, profitable, efficient, reliable, consumer orientated grid required to meet the challenges of the future with minimum impact to the environment.

This module is relevant to the Energy Engineers because future managers of energy companies need to be able to build strategic plans that will determine the performance and ultimately the profitability of their domain. They will need to make informed decisions about which technologies they adopt to best suit these operation requirements.

Evaluation procedure:

Group Project Report + Class Presentation:	30 %
2 Minor Test:	25 % both
Major test:	45 %

Details of course content and allotted time

S. No.	Topic	Allotted time (hrs)		
		L	T	P
1	**Introduction:** Introduction – What is driving the move towards Smart Grids globally and in India? What is a Smart Grid. Overview of how Indian power market is organised, operated and challenges being faced. Overview of how the Indian GENERATION, TRANSMISSION and DISTRIBUTION business is operated and controlled and some of the challenges being faced. How software can manage generation and optimise generator performance, Software to support integration of renewables, System planning & condition monitoring based maintenance, Forecasting & basic trading, Demand response, Performance management	7		
2	**Communication in Power Systems:** Overview of power sector communications, Generic model of communication network needed for Smart-grid, Introduction to different communication technologies available in the market (Latest standards. Emphasis on importance of inoperability and standardization of communication protocols), Matrix of different technologies against the smart-grid communication needs in a given utility environment, AMI, AMR & MDA: How it works and how it will help to; reduce peaks manage networks more efficiently and contribute towards smarter grids, Communication Standards IEC6150, Wide Area Situation Awareness (WASA), Network stability and Phasor Measurement Unit (PMU),	6		

	Automation and Integration of Distributed Generation / Renewable Energy, Automation and Micro-grids			
3	**Smart Grid Technologies:** How Distribution Management Systems (DMS) and Meter Data Management (MDM) are improving energy efficiency and security of supply in Distribution Systems, Demo/Simulation – Situation Awareness & optimisation of network operations, Overview of Power Electronics in Electrical T&D Systems, Power Electronics in emerging Smart Grids, Transmission (DC Super Grids) , Distribution (PE facilitating the integration of, (Distributed Generation, Renewables, Microgrids, Virtual Power Plants (VPP), Storage, Fault Current Limitation, Power Electronics, Super Conducting and Magnetic types), Developing technology and systems that will enable grids to work smarter in the future: Storage: Organic and Inorganic Salts & Synthetic Heat Storage, Developing technology and systems that will enable grids to work smarter in the future (Smart Meters, Recording consumption, Advanced payback options for load-management, Communication between the utility and customer's home (for home automation)), In-home controls, Demand Side Management (DSM). *Field Visit to National Load Dispatch Center*	7		4
4	**Smart Grid Policy and regulation:** Power Trading & the India Energy Exchange : Encouraging Markets, Regulation enabling grids to work smarter in India, Project Financing: Financial Incentives to Enable Smart Grids in India, Smart Grid Economics: Making Smarter Grids Financially Viable, Planning for Smarter Grids	6		
5	**Transmission and Distribution challenges in Smart Grids:** Challenges faced by the Transmission System (How to be more energy efficient, stable, reliable and environmentally friendly, How to move towards a vertically harmonised power sector that includes customers as stakeholders, Integration of bulk renewable generation & generator optimization, State/country interconnection, Energy exchange/trading), Developing technology and systems that will enable smarter transmission of bulk energy (Metering, Trading mechanisms, AC – FACTS (Statcom) DC – HVDC, Fault Current Limiters), Challenges faced by the Distribution Networks:(How to be more energy efficient, stable, reliable and environmentally friendly, Reducing losses, Integration of renewables Connecting/disconnecting micro-grids and virtual power plants, How to manage bi-directional energy flows), Developing technology and systems that will enable smarter distribution networks (DC – MVDC, Fault Current Limiters, Others (AC/DC TXs etc))	6		
6	**Electrifying rural India through Smart grid**: Electrifying India's rural community and the challenges being faced.(Developing technology and systems that will enable smarter rural electrification, Financing programmes, Virtual power plants, Solar power, Geothermic power, Micro CHP), Smart Utilities (case studies), Presentation on the Smart Grid Maturity Model (SGMM), Architecture for smart grids.	4	4	
7	Project Presentation Preparation			
	Total	**36**	**4**	**4**

Recommended readings

References:

1. Join Gridwise & Smartgrids groups in LinkedIn http://www.linkedin.com/
2. Sign up to Smart Grid News www.smartgridnews.com
3. US DoE Smart Grid Book
   http://www.oe.energy.gov/DocumentsandMedia/DOE_SG_Book_Single_Pages(1).pdf
4. Technology enabling the transformation of India's power distribution
   http://www.infosys.com/newsroom/features/power-sector-report.pdf
5. Gridwise Alliance website http://www.gridwise.org/
6. European Union Smart Grids Technology Platform http://www.smartgrids.eu/

News Exchange Group: (will be created)

1. Post message: TERIsmartgrids@yahoogroups.co.in
2. Subscribe: TERIsmartgrids-subscribe@yahoogroups.co.in
3. Group home page: http://in.groups.yahoo.com/group/TERIsmartgrids
4. Group email address: TERIsmartgrids@yahoogroups.co.in

Journals and Magazines:

1. IEEE Transactions on Power Systems.
2. IEEE Transaction on Smart Grid

Reviewers:

1. Dr Nagaraja Ramappa, MD, Power Research and Development Consultants, Bangalore
2. Mr Arun Mishra, Additional General Manager, Power Grid Corporation of India