

Course Type	Course Code	Name of the Course	L	T	P	Credit
DC	NEEC507	Smart Grid Technology	3	1	0	4
<b>Course Objectives:</b>						
<ul style="list-style-type: none"> <li>The topics of the course focus on basic concept of Smart Grid, various types of smart-grid devices that are used in the power industry. Emphasis is placed on the operation, installation and demand side management of smart-grid</li> </ul>						
<b>Learning Outcomes:</b>						
Upon successful completion of this course, students will acquire: <ul style="list-style-type: none"> <li>in-depth knowledge on smart grid and the what will be the futuristic grid.</li> <li>in-depth knowledge on issues while implementing the smart grid approach.</li> <li>in-depth knowledge on the concept of microgrid and distributed generation.</li> <li>in-depth knowledge on the need of communication technology in smart grid.</li> </ul>						
Unit No	Topics to be covered	Lecture + Tutorial Hours	Learning Outcome			
1	<b>Introduction:</b> Revision of classical power systems, challenges with existing grids, introduction to smart grid, smart grid objectives, definitions, features, and architecture, smart grid systems and solutions, smart grid standards, challenges to smart grids	5L+T0	Knowledge gain on smart grid architectures, solutions, and systems.			
2	<b>Distributed generation:</b> Principle of operation of various distributed generation technologies, wind profiles, maximum power extraction, plug-in hybrid electric vehicle	8L+3T	Knowledge gain on distributed generation resources and their integration and control			
3	<b>Smart grid monitoring:</b> SCADA, wide area monitoring, protection, and control, phasor measurement units, dynamic phasor calculation, smart metering, automatic meter reading and automatic metering infrastructure, introduction to state estimation	5L+3T	Knowledge gain on smart grid monitoring through synchrophasor data.			
4	<b>Smart grid protection:</b> Fault detection, isolation, and restoration, implementation of FDIR, islanding detection techniques, digital relay, relay coordination	5L+3T	Knowledge gain on the concept of islanding and their effective detection and fault detection and isolation in smart grid environment.			
5	<b>Control of transmission and distribution systems:</b> Control of transmission and distribution systems for smart grid, microgrid types, configurations, architectures, and control	10L+2T	Knowledge gain on control of transmission and distribution system and microgrids for smart grid operation.			
6	<b>Energy management:</b> Introduction to demand side management, customer load pattern, categories of power generation, demand response implementation, types of price signals, types of energy storage systems, introduction to battery management system, energy management in isolated and grid-connected systems	7L+3T	Knowledge gain on role of customer in smart grid operation, energy storage systems, and energy management in smart grid environment.			
7	<b>Conclusion:</b> Simulation of microgrid test cases, design of smart grid test bed, conclusion	2L+0T	Knowledge gain on simulation of smart grid test cases and design of a smart grid.			
<b>Total Contact Hours</b>		<b>42L+14T</b>				

**Text Book:**

- Borlase S., Smart Grids Infrastructure, Technology, and Solutions, 1<sup>st</sup> Edition, CRC Press, 2013, eBook ISBN: 9781315217833, DOI: 10.1201/b13003.

**Reference Books:**

- Masters G.M., Renewable and Efficient Electric Power Systems, 2<sup>nd</sup> Edition, Wiley, 2013, Print ISBN: 978-1-118-14062-8, eBook ISBN: 978-1-118-63350-2.
- Rufer A., Energy Storage Systems and Components, 1<sup>st</sup> Edition, CRC Press, 2017, Print ISBN 9781138082625, eBook ISBN: 9781315112404, DOI: 10.1201/b22265.
- Phadke A.G., and Thorpe J.S., Synchronized Phasor Measurements and Their Applications, 1<sup>st</sup> Edition, Springer, 2008, eBook ISBN: 978-0-387-76537-2, DOI: 10.1007/978-0-387-76537-2.
- Research publications in IEEE and IET journals