RESILIENT POWER GRID OPERATION USING SYNCHROPHOSOR TECHNOLOGY: A SMART GRID OPERATION PERSPECTIVE

Overview of the course:

Electric Power grid is considered to be the most complex machine man has ever invented. A Blackout in a national power grid halts the nation and the consequences are disastrous for the economy and society at large. Two of the biggest blackouts ever experienced by mankind occurred in India in 2012. Blackout is caused by a cascading sequence of loss of power system components. In technical terms, some instability mechanism typically leads to a blackout and for operational reliability and resiliency of the smart power grid, it is important to understand the basics of power system stability and how the instability mechanisms can be detected and mitigated using modern wide-area monitoring infrastructure of the future power grid. This is the focus of the proposed short course.

Power system stability concepts have evolved over time with the growth of interconnected power grids all over the globe and this subject is normally taken up by post graduates or by undergraduate programs in the final year of their degree programs. However, during the past decade, the subject of power system stability has been replaced by other subjects owing to developments in other areas of electrical engineering. Because of this, there is extreme shortage of personnel with the knowledge of power system stability which makes the grid vulnerable to the problems of instability that can potentially lead to crippling blackouts. Recently with integration of large size nonconventional energy sources like wind farms, solar farms etc. the operation of the grid is facing new challenges from the intermittent nature of renewable power generation and the related uncertainty issues in maintaining adequate energy supply at all times. Therefore, there is a recent and urgent need to upgrade the present grid to a resilient smart grid. A relatively new technology which uses wide-area synchronized measurements known as synchrophasors or Phasor Measurement Units (PMUs), is being deployed on power grids worldwide to meet this objective. Therefore, the study of power system stability monitoring and control using PMUs has gained importance and could not be neglected by power engineering students.

On completion of this one week course, the course participants will have an enhanced understanding of the principles behind the power system stability monitoring and control in relation to power system operational reliability. This course also helps participants to get a deeper appreciation of various types of power system stability, the basics of PMU technology, application of PMUs in power grid operation, and techniques towards building and operation a resilient smart grid. Lectures will be complemented with problem solving sessions and relevant software demonstrations in laboratory.

Modules	This course consists of one module only. 17 December 2018 to 21 December 2018
You should attend if you are	• Students of B. Tech, M.Tech, Ph.D. research scholars and faculty members of academic institutions and technical institutions. • Executives, engineers and researchers from utilities, service and government organizations, including R&D laboratories.
Registration Fees	The participation fees for attending the course is as follows: **Overseas Participants: US$ 200** **Industry/ Research Organizations: Rs. 5000** **Participants from Academic Institutions: Rs. 2000 (Rs. 1000 for SC/ST participants)** **Research Scholars/Students/Alumni: Rs. 1000 (Rs. 500 for SC/ST participants)** After registration on GIAN portal http://www.gian.iitkgp.ac.in/GREGN/index, the candidates are advised to submit the prescribed fee in the form of DD in favor of **"Registrar, DTU"** payable at Delhi along with printout of online submitted application form to **Prof. S T Nagarajan, Course Coordinator (GIAN), Professor, Department of Electrical Engineering, Delhi Technological University, Bawana Road, Delhi-110042** on or before **07.12.2018**. The shortlisted participants will be informed through e-mail. The above fee includes all instructional materials, computer use for tutorials and assignments and laboratory equipment usage charges. **The course fee does not include boarding and lodging.**

Teaching Faculty

Prof. Mani Venkatasubramanian is currently a faculty in Washington State University, Pullman, USA. He received his B.E. (Honors) degree in Electrical and Electronics Engineering from Birla Institute of Technology and Science, Pilani, India in 1986, and M.S. and D.Sc. degrees in Systems Science and Mathematics from Washington University, St. Louis, MO, in 1989 and 1992 respectively. He is a Fellow of IEEE and a recipient of NSF Young Investigator Award, National Science Foundation (1994 – 1999). He served as an invited member of Operating Capability Study Group, Western Systems Coordinating Council that was responsible for simulation and analysis of two major black-outs which occurred in the western electric grid, USA, in the summer of 1996. His teaching areas include Power system analysis, Power system dynamics, planning and control, Linear systems, Nonlinear systems, Control engineering, Bifurcation theory, Probability theory and Stochastic systems. His research interests include Nonlinear dynamics with emphasis on power system stability and control, Design of wide-area controls for large power systems, Analysis of complex chaotic behavior in large power system models and Power system stability monitoring using synchrophasors. He has coauthored the book "Application of time-synchronized measurements in power system transmission networks", Springer Verlag, 2014 and several other book chapters on power system stability. He has published over 100 papers in leading journals and IEEE conferences. He holds three patents in USA. His research team at Washington State University (WSU) has received research funding for several million dollars from US Department of Energy, National Science Foundation and North American electric power industry for developing synchrophasor based wide-area monitoring and control technology. Synchrophasor tools developed by Prof. Mani's research team at WSU have been implemented in several power grids in North America and in India.

Host Faculty

Dr. S.T.Nagarajan is professor in Electrical Engineering Department of Delhi Technological University, Delhi, India. He completed his B.E graduation in Electrical and Electronics Engineering from Thiagarajar College of Engineering, Madurai in 1994 and post-graduation in High Voltage Engineering from Anna University, Chennai in 1996. He obtained his Ph.D degree in area of Power system form Delhi University in 2015. He is Fulbright scholar for post-doctoral research at Washington State University, USA in 2017. Since 1996 he has been in teaching for undergraduate and postgraduate program and is with Delhi Technological University (Formerly Delhi College of Engineering) from 1999. He has been teaching the subjects of Electrical machines, power system and stability at DTU. His area of research interest includes wide area monitoring, Power system stability and High Voltage engineering.

Course Coordinator

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For Registration:
http://www.gian.iitkgp.ac.in/GREGN/index

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Dec 17-21, 2018

Dec 17: Registration and Inauguration 9.00AM-11.00AM

Monday Dec 17	11.00 AM – 1.00 PM	Lecture 1 (MV):	Introduction to Power system Stability
	2.30 PM – 4.30 PM	Tutorial 1 (STN):	Tutorial session
Tuesday Dec 18	9.30 AM-11.00AM	Lecture 2 (MV):	Classification of Power system stability
	11.30AM- 1.00PM	Lecture 3 (MV):	Concepts of Angular Instability
	2.30 PM- 4.30 PM	Tutorial 2 (STN):	Tutorial session
Wednesday Dec 19	9.30 AM-11.00AM	Lecture 4 (MV):	Concepts of Voltage Stability
	11.30AM- 1.00PM	Lecture 5 (MV):	Concepts of Frequency Stability
	2.30 PM- 4.30 PM	Tutorial 3 (STN):	Tutorial session/Lab
Thursday Dec 20	9.30 AM-11.00AM	Lecture 6 (MV):	Concepts of power system Oscillations and smart grid concepts
	11.30AM- 1.00PM	Lecture 7 (MV):	Introduction to synchrophasor technology
	2.30 PM- 4.30 PM	Laboratory (STN):	Demonstration softwares used for analysis in laboratory
Friday Dec 21	9.30 AM-11.00AM	Lecture 8 (MV):	Oscillation monitoring and control
	11.30AM- 1.00PM	Lecture 9 (MV):	Synchrophasor based stability monitoring in resilient smart power grids
	2.30 PM- 4.30 PM	Evaluation	Test and Certificate distribution to the participants