SMART Power Flow Controller for Smart Grid Applications

Overview of the course:

'Smart Grid' is an initiative to modernize the existing electric power system, which is envisioned to be integrating necessary devices for its most efficient and reliable operation. The most discussed areas in Smart Grid are Distribution, Automation and Communication. The least discussed area in Smart Grid is Power Flow Control, without which the development of Smart Grid is incomplete.

The use of electrical energy is increasing worldwide and so are its various sources from traditional coal, nuclear, hydro, oil to renewable solar, wind, bio-fuel, tidal, and so on. Currently, there is not enough transmission capacity to transport new electrical energy from the generating stations (sources) to the population centers (loads).

The power industry's pressing need for the most economical ways to transfer bulk power along a desired path may be met by building new transmission lines, which is a long and costly process. Alternately, it may be quicker and cheaper to utilize the existing transmission lines more efficiently. The key is to identify the underutilized transmission lines and harness their dormant capacity to increase the power flows up to the lines' thermal limits.

Power flow control techniques have been practiced, from using inductors, capacitors, transformers and load tap changers in the earlier days of electrical engineering to power electronics-based solutions in recent years. Even though the costs of the available solutions vary widely, the basic underlying theory of power flow control is still the same as it always has been. The question is which solution one should employ. The answer depends on knowing what the true need is.

It is often desirable to increase the available transfer capacity (ATC) of a line up to its thermal limit so that the line can be utilized to its fullest extent. Sometimes, it may be desirable to lower the ATC so that power flow can be redirected to a desired transmission line that may include high-voltage, low-loss lines. It may also be desirable to avoid tripping an overloaded line, which may otherwise lead to a cascaded failure, resulting in a possible blackout.

The presentation is designed to provide the basic principles of power flow control theory, an overview of the most commonly used power flow controllers, and future trends. The presentation will be of particular interest to all utility power engineering professionals. The required background is an equivalent of an Electrical Engineering degree with familiarity in power engineering terminology. The audience will hear from an expert who actually designed and commissioned a number of power electronics-based FACTS controllers since its inception in the 1990s.

Modules	**This course consists of one module only.** **18 December 2017 to 23 December 2017**
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 **Mr. Kuldeep Singh, Course Coordinator (GIAN), Assistant Professor, Department of Electrical Engineering, Delhi Technological University, Bawana Road, Delhi-110042** on or before **10.12.2017**. 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

Dr. Kalyan Sen, a newly selected Fulbright Scholar, is the Chief Technology Officer of Sen Engineering Solutions, Inc. (www.sentransformer.com) that specializes in developing SMART power flow controllers—a functional requirements-based and cost-effective solution. He spent 30 years in academia and industry and became a Westinghouse Fellow Engineer. He was a key member of the Flexible Alternating Current Transmission Systems (FACTS) development team at the Westinghouse Science & Technology Center in Pittsburgh. He contributed in all aspects (conception, simulation, design, and commissioning) of FACTS projects at Westinghouse. He conceived some of the basic concepts in FACTS technology. He has authored or coauthored more than 25 peer-reviewed publications, 8 issued patents, a book and 4 book chapters in the areas of FACTS and power electronics. He is the coauthor of the book titled, Introduction to FACTS Controllers: Theory, Modeling, and Applications, IEEE Press and John Wiley & Sons, Inc. 2009, which is also published in Chinese and Indian paperback editions. He is the co-inventor of Sen Transformer. He received BEE, MSEE, and PhD degrees, all in Electrical Engineering, from Jadavpur University, India, Tuskegee University, USA, and Worcester Polytechnic Institute, USA, respectively. He also received an MBA from Robert Morris University, USA. He is a licensed Professional Engineer in the Commonwealth of Pennsylvania. He is a Distinguished Toastmaster who led District 13 of Toastmasters International as its Governor to be the 10th-ranking District in the world in 2007-8.

Kalyan Sen, a Senior Member of IEEE, has served the organization in many positions. Under his leadership, IEEE Pittsburgh Section and its three chapters (PES, IAS and PELS) received Best Section and Chapter Awards. His other past positions included Editor of the IEEE Transactions on Power Delivery (2002 – 2007), Technical Program Chair of the 2008 PES General Meeting in Pittsburgh, Chapters and Sections Activities Track Chair of the 2008 IEEE Sections Congress in Quebec City, Canada, PES R2 Representative (2010 and 2011) and Member of the IEEE Center for Leadership Excellence (CLE) Committee (2013, 2014). He has been serving as an IEEE PES Distinguished Lecturer since 2002. In that capacity, he has given presentations on power flow control technology more than 100 times in 15 countries. He is an inaugural class (2013) graduate of the IEEE CLE Volunteer Leadership Training (VOLT) program. Kalyan Sen is the recipient of the IEEE Pittsburgh Section PES Outstanding Engineer Award (2004) and Outstanding Volunteer Service Award for reviving the local Chapters of PES and IAS from inactivity to world-class performance (2004). He has been serving as the Special Events Coordinator of the IEEE Pittsburgh Section for the last decade. He is the Region 1, 2&3 Coordinator of IEEE Power Electronics Society.

Host Faculty

Prof. Suman Bhowmick is a Professor and an Associate Head in the Department of Electrical Engineering, Delhi Technological University (DTU), Delhi. He received his B.E. (Hons.) and M.E. degrees in Electrical Engineering from Jadavpur University Kolkata and his Ph.D degree from the University of Delhi, Delhi. His areas of interest are Power Systems, FACTS, VSC-HVDC and Distributed Generation. He has published about 20 papers in International and National Journals and Conferences. He has also authored a book on Newton Power-Flow Modelling of VSC Based FACTS Controllers, published by the CRC Press, USA in 2016. He is a life member of ISTE.

Mr Kuldeep Singh is currently an Assistant Professor in the Department of Electrical Engineering, Delhi Technological University, Delhi, India. He completed his B. Tech. in Electrical Engineering from Indian Institute of Technology Ropar, Punjab in 2013 and M. Tech in Power Systems from Delhi Technological University, Delhi in 2016. He joined the Department of Electrical Engineering, Delhi Technological University (DTU) in 2016. His area of interest is Power Systems.

Course Coordinators

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

SMART Power Flow Controller for Smart Grid Applications

Course Schedule (18 December 2017 to 23 December 2017)

18 December 2017
Registration: 9.30 AM to 10:30 AM
Inauguration: 10:30 AM to 12:00 NOON

Date	Day	Time	Type of Class	Topic
18th December 2017	Monday	12:00 Noon – 1.30 PM	Lecture 1	Introduction to Smart Grid and SMART Power Flow Controllers
		2.30 PM – 4.00 PM	Lecture 2	Emerging trends in power flow control
19th December 2017	Tuesday	10 AM – 11.30 AM	Lecture 3	Demonstration of power system modeling using EMTP
		12:00 Noon – 1:30 PM	Lecture 4	Power electronics inverter
		2.30 PM – 4.00 PM	Tutorial 1	Working with EMTP
20th December 2017	Wednesday	10 AM – 11.30 AM	Lecture 5	Voltage Control – non power electronics and thyristor-based
		12:00 Noon – 1.30 PM	Lecture 6	Voltage Control – power electronics inverter-based
		2.30 PM – 4.00 PM	Tutorial 2	Working with EMTP
21st December 2017	Thursday	10 AM – 11.30 AM	Lecture 7	Reactance Control – non power electronics and thyristor-based
		12:00 Noon – 1.30 PM	Lecture 8	Reactance Control – power electronics inverter-based
		2.30 PM – 4.00 PM	Tutorial 3	Working with EMTP
22nd December 2017	Friday	10 AM – 11.30 AM	Lecture 9	Impedance Control – power electronics inverter-based
		12:00 Noon – 1.30 PM	Lecture 10	Impedance Control – non power electronics and thyristor-based
		2.30 PM – 4.00 PM	Tutorial 4	Working with EMTP
23rd December 2017	Saturday	10:00 AM – 11.30 AM	Lecture 11	Power flow management using Generalized Power Flow Controller
		12:30 PM – 1.30 PM	Evaluation	Written test for participants
		2.30 PM – 4.00 PM	Valedictory function	