

# HVDC Transmission and FACTS

---

## Overview

The power grid is undergoing dramatic changes to cope with the technological and social demands. Enabling this change and leaning to improved flexibility reliability and efficiency was the usage of power electronic devices and their controllers. The conventional power grid was first modified with the introduction of HVDC transmission in the 1950's with mercury arc rectifiers. It underwent another transformation with the advent of the thyristor converter in the 1970's, and then in the mid 1990's with the Voltage Source Converter with IGBT switches. The management of reactive power became an issue that was dealt with the SVC and then with STATCOM. By this time, the advent of the flexible ac transmission (FACTS) also became a reality. These developments continued as the ac power grid became highly integrated and meshed. The global warming issue became prevalent in the 2000's and the power grid was faced with the integration of green energy. The computer, internet and telecommunications age then took hold and the grid had to evolve as well towards the entity known as the smart grid. The trend towards renewable and embedded generation and shift away from fossil fuels to minimize global warning and greenhouse gas emissions is leading the change in the power grid. The developments in the photo-voltaic based generation, and battery storage are leading to the increased usage of electrical vehicles and formation of microgrids. This new era will now focus on the improvement of flexibility, reliability and efficiency of the power system.

***The course aims to take both the beginner and the seasoned researcher, a step forward to explore the frontiers in HVDC Transmission and FACTS.***

## Contents

- Introduction to HVDC Transmission, Types of Converters for HVDC Systems, Synchronization techniques for power converters, HVDC Controls, Forced Commutated HVDC Converters, Capacitor commutated converters for HVDC applications, Numerical examples on HVDC applications, HVDC Converters, Simulators for HVDC systems, Voltage Source Converters for HVDC systems, Modern HVDC Trends, problem solving session with examples on HVDC AC-DC system, numerical examples on simulation case study, Typical disturbances in HVDC systems.
- Introduction to FACTS, Static Compensators – STATCOM based on Chain link converters, Active Filters and UOIT Microgrid application, Numerical example on Active Filters and Microgrid applications.
- New trends in Power System Protection and Control Techniques.



## Course Coordinator

**Dr. Manoj Tripathy**

Phone: +91-1332-285431

E-mail:manojfee@iitr.ac.in

.....  
<http://www.gian.iitkgp.ac.in/GREGN>

<b>Dates</b>	<b>Dec 17 - Dec 21, 2018</b> Number of participants for the course will be limited to fifty.
<b>You Should Attend If...</b>	<ul style="list-style-type: none"> <li>▪ You are an electrical engineer or computer engineer or research scientist interested in HVDC transmission, FACTS, Smart Grid, Electric Power Drives, and Power System.</li> <li>▪ You are students at all levels (BTech/MTech/MS/PhD)</li> <li>▪ You are faculty from reputed academic institutions and Executives, engineers and researchers from manufacturing, service and government organizations including R&amp;D laboratories.</li> </ul>
<b>Registration Procedure</b>	<b>Step 1: GIAN Web Portal Registration:</b> Register in the GIAN portal <a href="http://www.gian.iitkgp.ac.in/GREGN/index.">http://www.gian.iitkgp.ac.in/GREGN/index.</a> , by paying Rs. 500/- online.

Registration to this portal is one time affair and will be valid for lifetime of GIAN. Please note that Course fee is separate.

**Step 2: Course Registration:** Login to the GIAN portal with the registered User ID and Password. Choose for the Course registration option. Select the course titled “**HVDC Transmission and FACTS**” from the list and click the “Save” option. Confirm your registration by clicking the suitable option.

**Last date for the registration of this course is 1<sup>st</sup> November 2018.**

**Step 3: Course Shortlisting:** Candidates will be intimated through email regarding their selection.

**Step 4: Course Fee Remittance:** Once you receive the intimation from the Course Coordinator, the fee (as applicable) need to be paid. The participation fees for taking the course is as follows:

**Participants from abroad : US \$250**

**Professionals from Industry/Research Organizations: INR 15000**

**Faculty from other Academic Institute: INR 10000**

**Student from other Academic Institute: INR 5000**

The above fee include instructional materials, computer use for tutorials and assignments, laboratory equipment usage charges, 24 hour free internet facility. The participants will be provided with accommodation on payment basis.

The details of fee payment by Electronic Clearing Service/ RTGS in the name of “DEAN SRIC IITR”.

INSTITUTION ACCOUNT NAME	Conference, Seminar & Symposium IIT Roorkee
ACCOUNT NO.	33136732957
IFSC CODE	SBIN0001069
BANK NAME	State Bank of India
BRANCH NAME	IIT Roorkee
COMPLETE BRANCH ADDRESS	Indian Institute of Technology Roorkee, Roorkee-247667
MICR NO.	247002094
ACCOUNT TYPE	Saving
IITR PAN NO.	AAALI0033R

**Step 5: Send Registration Form to Course Coordinator:** Fill up the registration form (Given at end of this brochure), by providing details of the bank transaction. Send the registration form to the Course coordinator at [gianhvdc2018@gmail.com](mailto:gianhvdc2018@gmail.com)/ [manojfee@iitr.ac.in](mailto:manojfee@iitr.ac.in) **on or before 1<sup>st</sup> November 2018.**

## The Faculty



**Prof. Vijay K. Sood** obtained his Ph.D. in Power Electronics from the University of Bradford, England in 1977. From 1976-2007, he was a Senior Researcher at IREQ (Hydro-Québec) in Montreal. And in 2007, he joined University of Ontario Institute of Technology (UOIT) as an Associate Professor. He is a Member of the Professional Engineers Ontario, a Life Fellow of the Institute of Electrical and Electronic Engineers (IEEE), and a Fellow of the Engineering Institute of Canada (EIC) and Emeritus Fellow of the Canadian Academy of Engineering (CAE). He is a past Managing Editor of the IEEE Canadian Review (a quarterly journal for IEEE Canada), past Chief Editor of the Canadian Journal of Electrical and Computer Engineering, and past Editor of the IEEE Transactions on Power Delivery. He is the recipient of the 1998 Outstanding Service Award from IEEE Canada, the 1999 Meritas Award from the Ordre des ingénieurs du Québec, IEEE Third Millennium Award from IEEE (2000), IEEE Regional Activities Board Achievement Award (2001), CP Railway Engineering Medal from Engineering Institute of Canada (2002), IEEE Regional Activities Board Achievement Award (2006). Prof. Sood is a well-known expert in HVDC and FACTS transmission systems. His research interests are in the monitoring, control and protection of power systems. Lately, he is responsible for the UOIT Microgrid – the largest (8 MW) microgrid installation in Canada. Prof. Sood has published over 150 articles and written two books on HVDC Transmission (now translated into Chinese and Russian languages).



**Dr. Manoj Tripathy** received the B.E in Electrical Engineering from Nagpur University and M.Tech. specialization of Instrumentation and Control from Aligarh Muslim University in 1999 and 2002 respectively. Dr. Tripathy received Ph.D. degree from the Indian Institute of Technology Roorkee in 2008. He worked as Post Doctorate Fellow in University of Western Ontario, Canada under BOYSCAST Fellowship in 2009-10. His research interest is in the area of Power System Protection and Signal Processing. He has published twenty five International & National Journal papers and more than 46 papers in International and National Conferences research papers during his more than 12 years teaching career at graduate and post-graduate levels in different Indian Universities. He is currently working as Associate Professor in Department of Electrical Engineering, Indian Institute of Technology Roorkee. He is a Senior Member of the Professional Engineers such as Institute of

Electrical and Electronic Engineers (IEEE), and Life member of the Institution of Engineers (India). He is reviewer of various International Journals like IEEE Transaction Power Delivery, IET Proceedings Generation, Transmission and Distribution, IET Electric Power Application's, IET Science, Measurement & Technology, Simulation Modeling Practice and Theory etc.

## **ABOUT ROORKEE**

Roorkee is a part of the State of Uttarakhand and is located at the foothills of Himalayas. The nearest Airports are – Jolly Grant Airport in Dehradun and New Delhi International Airport in Delhi. The place is also within easy reach by road from Delhi (200 km) and Dehradun (70 km). Roorkee Railway Station is on the main line of Northern Railways having direct links to Delhi, Mumbai, Calcutta, Amritsar, Jodhpur and Shri Ganganagar. The place is also within easy reach by road from Delhi (200 km) and Chandigarh (180 km). It is located on Delhi – Haridwar and Delhi – Dehradun bus routes. Roorkee is ideally located near several tourist places, like Dehradun (70 km), Mussorie (100 km), Haridwar (32 km) and Rishikesh (50 km).

# REGISTRATION FORM

---

**GIAN Course  
on  
HVDC Transmission and FACTS  
(17<sup>th</sup> -21<sup>st</sup>, December 2018)**

Name: \_\_\_\_\_

Designation: \_\_\_\_\_

Organization: \_\_\_\_\_

Address: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

E-Mail: \_\_\_\_\_

Phone: \_\_\_\_\_

Mobile: \_\_\_\_\_

Fax: \_\_\_\_\_

Fees Payable to **"DEAN SRIC IITR"**, SBI, IIT ROORKEE

Transaction No.: \_\_\_\_\_

Dated: \_\_\_\_\_

Bank Name: \_\_\_\_\_

Rs. \_\_\_\_\_

*Signature of Applicant*