

# Recent trends in Protection of Microgrids with high DER penetration: Issues, Challenges and Mitigation

## Overview of the course:

Microgrids comprise low voltage distribution systems with distributed energy resources (DER) and controllable loads which can operate connected to the medium voltage grid or islanded in a controlled coordinated way. Though microgrids provide clear economic and environmental benefits for end- customers, utilities and society, they present challenges to the utility from protection, control, and dispatch perspective. Traditional protection is based on the fact that for a short circuit, significant over currents will flow in a direction towards the fault, whereas in a microgrid environment, a significant portion of the generation will be inverter-based which, through design, is current limited. New protection philosophies will need to be developed to protect these systems. Also, local generation in combination with a possible islanded operation can pose protection sensitivity and selectivity problems in case of faults depending on the relay settings. To avoid non-selective tripping of protection relays, the protection system of the future shall permanently be capable of identifying the actual state of operation and automatically defining and implementing new required protection settings. Further, protection must respond to both utility grid and microgrid faults. If the fault is on the utility grid, the desired response may be to isolate the microgrid from the main utility as rapidly as necessary to protect the microgrid loads. If the fault is within the microgrid, the protection coordinator isolates the smallest possible section of the microgrid to eliminate the fault.

<b>Modules</b>	<p><b>This course consists of one module only.</b>  <b>12<sup>th</sup> February, 2018 to 16<sup>th</sup> February, 2018.</b></p>
<b>You Should Attend If You are</b>	<ul style="list-style-type: none"> <li>▪ Students of B.Tech, MTech, Ph.D. research scholars and faculty members of academic institutions and technical institutions.</li> <li>▪ Executives, engineers and researchers from utilities, services and government organizations, including R&amp;D laboratories.</li> </ul>
<b>Registration Fees</b>	<p>The participation fees for attending the course is as follows:  <b>Overseas Participants: US\$ 200</b>  <b>Industry/ Research Organizations: Rs. 3000</b>  <b>Participants from Academic Institutions: Rs. 1000 (Rs. 500 for SC/ST participants)</b>  <b>Research Scholars/Students/Alumni: Rs. 500 (Rs. 250 for SC/ST participants)</b>            After registration on GIAN portal <a href="http://www.gian.iitkgp.ac.in/GREGN/index">http://www.gian.iitkgp.ac.in/GREGN/index</a>, 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 <b>Dr. Priya Mahajan, Course Coordinator (GIAN), Department of Electrical Engineering, Delhi Technological University, Bawana Road, Delhi-110042</b> on or before <b>31.01.2018</b>. The shortlisted participants will be informed through e-mail.</p> <p>The above fee includes all instructional materials, computer use for tutorials and assignments and laboratory equipment usage charges. <b>The course fee does not include boarding and lodging. The paid hostel/guest house accommodation may be provided on first come first serve basis with prior request.</b></p>

## Teaching Faculty



**Dr. Mukesh Nagpal**, is a Senior Member and distinguished lecturer of IEEE Power and Energy Society, Adjunct Professor at University of British Columbia, Vancouver, BC and a Professional Engineer in the Province of British Columbia. He received the Ph.D. and M.Sc. degrees in electrical engineering from the University of Saskatchewan, Saskatoon, SK, Canada. Currently, he is a Principal Engineer/Manager with the Protection and Control Planning Group within BC Hydro Engineering, Burnaby. He has more than 28 years of experience in electrical consulting, utility research, and power system protection. Dr. Nagpal has written about 50 technical papers on power system relaying and contributed to several ANSI/IEEE sponsored standards or guides on relaying practices. In 2016, the Association of Professional Engineers of British Columbia conferred Dr. Nagpal with its highest engineering honour, the R.A. McLachlan Memorial Award, for his exceptional leadership in developing practical and effective ways to connect renewables to the grid. He also received the Vancouver IEEE-PES Chapter's 2016 Outstanding Engineer Award. Dr. Nagpal is Fellow of Canada Engineers.

## Host Faculty



**Dr. Rachana Garg** is the Professor and Associate Head in Dept. of Electrical Engineering DTU. She has received B.E., M.Tech degree in Electrical Engg. from Maulana Azad College of Technology (NIT) Bhopal and Ph.D from Delhi University. She had guided one PhD and is guiding 04 more research scholars in the area of renewable energy and smart grid. She has organised many conferences, workshops and short term courses for faculty members and students and has published about 40 research papers in international and national journals and conferences. Her areas of interest are transmission and distribution systems, renewable energy systems, smart grid, artificial intelligent techniques and their application in power systems. She is a senior member of IEEE. Presently, she is the Chair, Student Activities Committee of IEEE Delhi Section and of PES-IAS Delhi Chapter. She is the faculty advisor of PES-IAS student chapter, DTU. She is also a life member of ISTE.



**Dr. Priya Mahajan** is currently an Associate Professor in Electrical Engineering Department of Delhi Technological University, Delhi, India. She completed her B.E. in Electrical Engineering from Thapar Institute of Engineering & Technology, Patiala in 1996 and post-graduation in Power System from Punjab Engg. College, Chandigarh in 1998. She has completed her doctorate from Delhi University in Electrical Engg. in 2015. She has been in academics since 1998 and is with Delhi Technological University (Formerly Delhi College of Engineering) from 2000. Her area of research interest includes railway electric traction system and power system.

## Course Coordinator(s)

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## Patron

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## For Registration:

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

# Recent trends in Protection of Microgridswith high DER penetration: Issues, Challenges and Mitigation

TentativeCourse Schedule(12<sup>th</sup> February, 2018 to 16<sup>th</sup> February, 2018)

12<sup>th</sup>February, 2018

Registration:9.00 AM to 10:00 AM

Inauguration: 10:00 AM to 11:00 AM

Date	Day	Time	Type of Class	Topic
12 <sup>th</sup> February, 2018	Monday	11.30AM – 1.30 PM	Lecture-1	Introduction to recent trends in distribution system protection
		2.30 PM- 4.30 PM	Lecture-2	Challenges and issues in protection of micro grids
13 <sup>th</sup> February, 2018	Tuesday	10.00AM – 11.30 AM	Lecture-3	Impact of Power Electronic Sources on Fault Protection
		12.00PM- 1.30PM	Lecture-4	Protection schemes for transmission lines when power electronic sources are present
		3.00PM – 4.30 PM	Tutorial 1	Problem solving session on modelling of power electronic sources and their impact on protection schemes.
14 <sup>th</sup> February, 2018	Wednesday	10.00AM – 11.30 AM	Lecture-5	Requirements for interconnecting a generating source to its distribution system
		12.00PM- 1.30PM	Lecture-6	Protection solutions for distribution connection of small generators
		2.30PM – 4.30 PM	Laboratory 1	Simulation and analysis of faults in power systems
15 <sup>th</sup> February, 2018	Thursday	10.00AM – 11.30 AM	Lecture-7	Use of modern off-the-shelf multifunction relays providing relaying schemes in a single device
		12.00PM- 1.30PM	Lecture-8	Case study to demonstrate the reliability of the schemes appliedusing Relay records from actual faults
		3.00PM – 4.30 PM	Tutorial-2	Problem solving session on different protection schemes
16 <sup>th</sup> February, 2018	Friday	10.00AM – 11.00 AM	Lecture-9	Effect of high penetration of synchronous DERs on fault current levels in microgrids
		11.30PM- 12.30PM	Lecture-10	Recent developments in the protective equipment.
		12.30 PM- 1.30PM	EXAMINATION	
		2.30PM- 4.30 PM	DISCUSSIONS AND VALEDICTORY FUNCTION	