Photovoltaic Array to Utility Interface Power Converters

Overview of the course:

To overcome the shortage of energy requirements and environmental concerns, use of alternate (or renewable) energy sources is becoming popular. Although there are several alternate energy sources available, photovoltaic (PV) arrays are popular due to their advantages such as they are static, safe, reliable, environmentally clean (green) and hardly require any repair and maintenance with an expected life time of about 20 years. Photovoltaic arrays convert sunlight into electricity in the form of dc voltage. Present day, most appliances and other electrical devices operate on utility line ac voltage of 60 Hz or 50 Hz. Therefore, it is necessary to convert the dc output from the PV array to the utility ac voltage and frequency. This is done by dc-to-ac inverters. Residential load power varies widely during the day (depends on the use of various appliances), usually supplied by the hydro line. One can use stand-alone inverter that requires a four quadrant operation (bidirectional power flow) to supply both active and reactive power (due to non-unity power factor loads) resulting in large size inverter with a higher cost. Stand-alone inverters require large size storage batteries charged by the PV array during day time. Utility interface inverter operates in parallel with the utility line (grid) while supplying the residential loads. Available utility distribution is used to balance the power flow between the PV array and the residential load. This is simpler and cost effective. Excess energy can be fed back to the grid that can be used by other users. Utility interactive inverter designed properly requires only unidirectional power flow between the PV array and utility line. Therefore, simpler and efficient inverter topology can be selected and no expensive storage is needed.

Modules	**This course consists of one module only.** **22 August 2016 to 27 August 2016.**
You Should Attend If You are	▪ Students of B.Tech, MTech, Ph.D. research scholars and faculty members of academic institutions and technical institutions. ▪ Executives, engineers and researchers from manufacturing, 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** **Research Scholars/Students/Alumni: Rs. 1000 (Rs. 500 for SC/ST students)** 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. Madhusudan Singh, Course Coordinator (GIAN), Department of Electrical Engineering, Delhi Technological University, Bawana Road, Delhi-110042** on or before 10.08.2016. 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. Ashoka Krishna Sarpangal Bhat obtained his M.A.Sc. and Ph.D. degrees from the University of Toronto, Canada, in 1982 and 1985, respectively. He joined the department of Electrical and Computer Engineering, University of Victoria in 1985 where he is now working as a professor. He has more than 40 years of experience in power electronics and has written more than 200 technical articles along with 8 books-chapters. He is a recipient of prestigious "**Teaching award**" from the faculty of Engineering, University of Victoria, Canada for "Excellence in teaching in the Faculty of Engineering" in 2008. For his outstanding contribution in "an innovative, distinctive, and exceptional way, to the instruction of undergraduate laboratory courses in Engineering at a Canadian University", he is sole recipient of **Wighton Fellowship** (only one award per year in Canada) in 2010. Dr. Bhat has guided more than 10 PhD students and around 14 Masters Theses/Projects. Currently 6 students are pursuing post graduate degree (PhD and Master) under his supervision. **He is an IEEE Fellow since 1998**, became IETE Life Fellow (India) in 1994. He has served as visiting professor at various institutes at national (like, Indian Institute of Science, India) and international (such as, The Hong Kong Polytechnic University, National University of Singapore) levels. He has offered several short term and full-semester courses in the area of Power Electronics.

Host Faculty

Prof. Madhusudan Singh is Head of Electrical Engineering Department and Dean Academic UG at Delhi Technological University, Delhi, India. He received his B.Sc.(Engg.) Degree in Electrical Engineering, M.E. degree and PhD. Degree from Faculty of Technology, Dayalbagh Educational Institute, Agra, India, University of Allahabad, Allahabad, India and University of Delhi, New Delhi, India respectively. He teaches power electronics and electrical machines at DTU. His research interests includes modelling and analysis of electrical machines, voltage control aspects of self-excited induction generators, power electronics and drives. Prof. Singh is a Fellow of the Institution of Engineers (IE), India and of the Institution of Electronics and Telecommunication Engineers, New Delhi, India. He is also a member of the IEEE, USA. He has 30 research papers in his credits and supervised three Ph.D thesis and many M.Tech dissertations.

Sudarshan K. Valluru is an Associate Professor in the Department of Electrical Engineering, at Delhi Technological University. He did B.Tech in Electrical and Electronics Engineering from Nagarjuna University, Guntur and M. Tech in Computer Applications in Industrial Drives from National Institute of Engineering, Mysore. He is published fifteen research papers in various international, national journals and conferences and also authored a book on 'Introduction to Neural Networks, Fuzzy Logic and Genetic Algorithms. His research and teaching interests are in the area of Electric Machinery, Non-linear dynamical systems and Meta algorithms. He is a fellow member IETE, and member IEEE, IE (I), ISTE.

Course Coordinator

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

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Tentative Course Schedule

22nd August 2016
Registration; 9:00 AM to 10:00 AM
Inauguration: 10:00 AM to 11:00 AM

Date	Day	Time	Type of Class	Topic
22nd August, 2016	Monday	11.30AM – 12.30 PM	Lecture-1	Review of PV array characteristics, peak power tracking and issues like effect of shading.
		1.30 PM-2.30 PM	Lecture-2	Need for PV array to utility interface, protection and regulatory requirements.
		3.00 PM– 5.00 PM	Laboratoty-1	Getting familiarized with PSIM simulation software
23rd August, 2016	Tuesday	10.00AM – 11.00 AM	Lecture-3	PV array to utility interface schemes – transformer less converters
		11.15AM-12.15PM	Lecture-4	Line-frequency transformer isolated converters
		2.00 PM– 5.00 PM	Laboratoty-2	Simulation of a line connected inverter for PV array.
24th August, 2016	Wednesday	10.00AM – 11.00 AM	Lecture-5	High-frequency transformer isolated converters, main principles of operation
		11.15AM-12.15PM	Lecture-6	Discussion on–performance of high-frequency transformer isolated converters
		2.00PM – 5.00 PM	Laboratoty-3	Simulation of a utility interfaced converter including boost converter with PV array.
25th August, 2016	Thursday	10.00AM – 11.00 AM	Lecture-7	Review of soft switching techniques for improvements in converters including analysis and design techniques.
		11.15AM-12.15PM	Lecture-8	PV array to utility interface converters operation, analysis, design and control details of unfolding current type inverters.
		2.00PM – 5.00 PM	Laboratoty-4	Simulation example of converter using soft-switched converter.
26th August, 2016	Friday	10.00AM – 11.00 AM	Lecture-9	PV array to utility interface soft-switched converter examples with their operation, analysis, design and control details.
		11.15AM-12.15PM	Lecture-10	PV array to utility interface soft-switched converter examples with their operation, analysis, design and control details (continued)
		2.00PM – 5.00 PM	Laboratoty-5	Simulation example of converter using soft-switched converter (continued). Possibly simulate a micro inverter if time permits.
27th August	Saturday	10.00AM – 11.00 AM	Lecture-11	Case studies of PV array to utility interface converters with their operation, analysis, design and control details
		11.15AM-12.15PM	Lecture-12	Micro inverters and future trends.
		1.30 PM-2.30 PM	Examination	
		4:30 PM-5:00 PM	Valedictory Function	