



Edison Memorial Lecture

Organized by

Department of Electrical Engineering, IIT Delhi

Jointly with

IEEE PELS-IES & PES-IAS Delhi Chapter



Date:	Time:	Venue:
22 th Nov., 2012	5.00 PM	IIA-106, Bharti School, IIT Delhi

Speaker: Prof. Ned Mohan, Department of Electrical and Computer Engineering, University of Minnesota.

Topic: Research in Power Electronics for Interfacing Renewables to Power Systems.

About the Speaker:

Ned Mohan is Oscar A. Schott Professor of Power Electronics in the Department of Electrical Engineering at the University of Minnesota, where he has been teaching for 35 years. He has written five textbooks; one of them is translated into several languages.

He has 16 patents and has written over 254 technical articles. 55-IEEE Transactions and Other Journals, 146-Refereed IEEE Conf. Proceedings, 40 Non-IEEE Proceedings, 13-Invited; includes some publications which were presented in conferences and then subsequently accepted in the IEEE Transactions as well. He is actively involved in the area of renewable energy and is working on the next generation of wind generators and storage.

He received the Distinguished Teaching Award by the Institute of Technology at the University of Minnesota. He is a Morse-Alumni Distinguished Teaching Professor and is a member of the Academy of Distinguished Teachers at the University of Minnesota. He received the Outstanding Educator Award from the Power Engineering Society of the IEEE in 2008. He is a Fellow of the IEEE.

Research:Power System Applications: Superconducting Magnetic Energy Storage; Effect of Geo-magnetically Induced Currents (GIC) in power systems, STATCOMs, EMTP-based Modeling and capability to include hysteresis losses in transformers.

Power Quality: Active Filters; Interface to draw sinusoidal grid-side currents at unity power factor.

Design and Control of Electric Machines; Efficiency Improvements.

Soft-Switching DC-DC Converters and DC-AC Inverters.

Power electronic converters for interfacing of Wind, PVs, EVs and Plug-in Hybrids.

Education: Indian Institute of Technology - Kharagpur, Electrical Engineering, B. Tech. 1967

University of New Brunswick (Canada), Electrical Engineering, MS 1969

University of Wisconsin - Madison, Nuclear Engineering, M.S. 1972

University of Wisconsin - Madison, Electrical Engineering, Ph.D. 1973

University of Wisconsin - Madison, Electrical Engineering, Post-doc 1973-1975

(G. Bhuvaneshwari)

(Prerna Gaur)

Chair

Secretary

IEEE PELS-IES Delhi Chapter

Edison Memorial lecture

By Prof. Ned Mohan

Research in Power Electronics for interfacing Renewable to Power System

The Edison Memorial Lecture took place on 22nd November 2012 at 5:00 pm in the Bharti School Building Room No: IIA 106 at IIT Delhi. Initially the PELS Chapter Chair Prof. G. Bhuvaneswari introduced the speaker. First portion was on how to modify UG and PG EE curriculum to make them more attractive. An effort in this direction had been initially taken up by University of Minnesota at Minneapolis. The courses developed and the associated laboratory experiments/ manuals are archived in www.ece.umn.edu/power/groups.

“Consortium of Universities for Sustainable Power (CUSP)” is a group of universities offering power engineering curriculum in the United States who are keen to make their power programme more popular and attractive. The website corresponding to this has teaching materials for various energy related courses. They have tutorial problems, video clips, lecture material etc. Pre-class videos are seen by the students before the class. Concept quizzes are held at the beginning of the class based on these short video clippings. Then quizzes/tests are conducted within the class itself after a brief discussion among the inmates of the class. Online homework problems are worked out by the students for better understanding.

Graduate courses are also being developed with collaborative effort from various faculty members (inclusive of tapping on the expertise from the retired faculty as well). Active learning classrooms are available which allow discussion and interaction among students and faculty through projectors.

The future of Power Electronics is bright because of its application in generation, transmission, distribution and utilization sectors. Power quality and FACTS are major application areas of power electronics in power system apart from the fact that power electronics also contributes in a big way to renewable power generation.

Four application areas of research in the University of Minnesota at Minneapolis were discussed by Prof. Mohan during the lecture.

- i. Drives –Converter configurations for eliminating bearing current due to common mode voltages and also to reduce DC-link capacitor size. The following configurations were discussed:
 - a. Two matrix converters used for open end winding induction motor
 - b. Three level converter fed drive.
 - c. Direct three-level matrix converter fed induction motor drive.
- ii. Power Electronic Transformers- Use of power electronic technology reduces the weight of transformer by 150 times approximately. First the Power at low frequency is converted to high frequency by an inverter; stepped up using High Frequency Transformer (HFT) and then back to low frequency at the output of the secondary of the HFT. The material used for core is Finemet as it can support 1.5 Tesla of flux density without saturation. Ferrite is not used as ferrite can support only 0.3 to 0.4 T.
- iii. Wind Energy: A 10 MW wind turbine is installed near the University of Minnesota campus. Permanent Magnet Synchronous generator is used along with the turbine with back to back power electronic

converters. The system is extensively being used by the research students for their studies on Wind Energy Conversion Systems.

- iv. Flywheel based energy storage: In this system, AC homopolar machine is being used. The speed of rotation of the flywheel will be around 36000rpm to 24000 rpm. Because of the high speed, even with a smaller flywheel large amount of energy storage can be done.

The lecture was very well received by the IEEE Members, students and other guests. In total, **17** IEEE members and **25** guests attended the lecture. There were very lively and fruitful interactions between Prof. Mohan and all the participants. The lecture was concluded with a vote of thanks by Prof. Bhuvaneshwari. Some of the pictures taken during the lecture are shown below:





