



# Sarvajanik Education Society

Sarvajanik College of Engineering & Technology

**(A constituent college of Sarvajanik University)**

## AICTE – ISTE SPONSORED ONE WEEK INDUCTION PROGRAM

**POWER ELECTRONICS FOR RENEWABLE ENERGY SYSTEMS**

**27/12/2021 to 01/01/2022**

Is the planet healing?

Well no! It'sreeling!!

It's reeling with the burden of greenhouse gases due to blind and uncontrolled usage of petroleum products to run automobiles and the conventional energy generation via coal diesel and oil! The planet is heating, water reservoirs shrinking, glaciers melting and the consequences are too scary and portray a very dismal picture of the bleak future!

Solution – are there any?

Yes, indeed!

In fact, many!

So let's implement them, yes we are doing that!

But do remember Rome was not built in a day!

So??

Let's make small, yet significant and constant efforts to heal the planet earth.

One of way is to harness the Renewable energy and creating awareness about its use, proposing new technology for its efficient use so as to lessen the hazards that have been and are being created by use of fossil fuel.

Therefore, to serve the purpose, Electrical Engineering Department of Sarvajanik College of Engineering and Technology, Surat conducted a one week online AICTE – ISTE SPONSORED

INDUCTION PROGRAM in name and style as “POWER ELECTRONICS FOR RENEWABLE ENERGY SYSTEMS” from 27/12/2021 to 01/01/2022.

The objective of the program was to bring the researchers and the experts on a common forum whereby the new trends and technological advancements in renewable energy namely, solar and wind were to be discussed. The related issues, challenges, applications and the solutions to each were to be discussed.

The schedule of the workshop was meticulously designed such that each day had at least three technical/non-technical sessions followed by a quiz based on the sessions of the day.

On the first day, after inauguration, a session on Silicon Photovoltaics and Power Control was conducted by Prof Dr.Ashish K. Panchal. Prof Panchal is a Professor & Head at Electrical Engineering Department, SardarVallabhbhai National Institute of Technology, Surat Gujarat. He has more than 24 years of teaching experience. Dr. Ashish completed his PhD from IIT Mumbai in 2010. His areas of interest lies in the solar cell manufacturing and applications and has authored more than 44 research papers.

Prof Ashish primarily talked on the need of renewable energy. He gave insight on solar photovoltaic and power electronics, its need and all the real time statistics about the present and future of solar generation in India thereby justifying the need of organizing this training program. Prof Ashish started with the basic construction of PV cells, their mathematical modelling, PV characteristic curve and tracking of maximum power point curves and different techniques for the same.

Prof Ashish also discussed various control strategies proposed by him and his fellow co-researchers on tracking of maximum power point by usage of appropriate hardware and control strategies.

This session was followed by a talk by Mr. Ajay Jain on Human values. Mr. Ajay Jain is a Mechanical Engineer from IIT Delhi in 1992 and has worked for 24 years in various capacities. His 13 years of industrial experience includes working with GAIL (India) and Hazira LNG Private Limited, a joint venture of Royal Dutch Shell. He is presently State Coordinator of AICTE for Universal Human Values Course in Induction Program for Engineers. His intellectual and spiritual interactions with Rev. A Nagraj, the propounder of Madhyasth Darsahn- the Theory of Coexistence, during his college days at IIT Delhi paved a new way into his life and introduced him to Jeevan Vidya – the Science of Life.

In his words, “Madhyastha Darshan holds the key to the problems the world is facing today, whether they are linked to interpersonal relationships, conflicts between countries, environmental issues like global warming, acid rains, depleting resources and the ever increasing divide between Haves and Have nots.”

He shared his views, knowledge and on the need of imbibing human values especially in present scenario when human is working closely with machine and is losing the human touch. The three proposals regarding human happiness through sensual happiness, relationships and wisdom were heart touching and surely have paved path for us engineers, the teachers to inner happiness and satisfaction through their deeds and behavior.

Day two was a very enthralling session as we had a chance to listen to a stalwart whose contribution in renewable energy is immense. It was none other than Prof Dr. Bhim Singh. Prof. (Dr.) Bhim Singh is the National Science Chair & Emeritus Professor at Electrical Department, I.I.T, Delhi.

Dr Singh has been chaired various institutes and bodies for several years namely, ABB Chair Professor, CEA Chair Professor, Chairman of BOG, Maulana Azad National Institute of Technology, Bhopal, National Science Chair . He is recipient of several awards He is also member of Governing Council of Central Power Research Institute. He has published more than 1000 research papers in Internal journals and has guided more than 100 Ph.D. dissertations, and 171 M.E./M.Tech./M.S.(R) theses. He has been filed 87 patents. He has executed more than eighty sponsored and consultancy projects. He has co-authored a text book on power quality: Power Quality Problems and Mitigation Techniques published by John Wiley & Sons Ltd. 2015.

His areas of interest include solar PV grid interface systems, MicroGrids, power quality monitoring and mitigation, solar PV water pumping systems, improved power quality AC-DC converters, power electronics, electrical machines, drives, flexible alternating transmission systems, and high voltage direct current systems.

Two sessions namely on Solar and Wind energy were organized each of one and half hour on day two of the workshop. Prof Bhim Singh shared his views on the present scenario and future growth of wind and solar generation in India. The two session were highly technology intensive wherein you discussed the highly advanced power electronics-based topologies used for grid connected and standalone wind and solar based micro grid energy systems. These works have paved new pathways for the researchers and faculty members working in the said area.

Session three of day two was on “Advance PV Module Technologies -The Expected Shift&WAAREE offerings” .It was meant to give an exposure to the manufacturing , assembling

commissioning of PV arrays by Er. Kavish Shah , a Senior Engineer, Research & Development, Waaree Energies Limited, Surat.

Waaree Energies Ltd. is the flagship company of Waaree Group, founded in 1989 with headquarters in Mumbai, India. It has India's largest Solar PV Module manufacturing capacity of 2 GW's at its plants in Surat and Umbergaon in Gujarat. Waaree Energies is amongst the top player in India in providing EPC services, project development, rooftop solutions, and solar water pumps and also as an Independent Power Producer. Waaree has its presence in over 350 locations nationally and 68 countries internationally. The session was very insightful.

Day 3 session 1 of the workshop kick started with a session on Experimental Implementation of Doubly Fed Induction Generator for Wind Energy Conversion System by one of the eminent researcher and Professor Dr. N Krishna Swami Naidu who is an Assistant Professor at Electrical Department IIT (BHU), VARANASI.

Dr Naidu completed his PhD from Indian Institute of Technology, Delhi in 2014 later he joined EED IIT BHU, Varanasi in 2018. Prof Naidu has expertise in the area of Power Electronics, Renewable Energy Integration to the grid, Smart Grid, Power Electronic Drives, Power Quality, and Hybrid Energy Storage Systems. He has published several research papers in reputed SCI journals and conference proceedings.

Prof Naidu delivered a talk on wind generation, specifically using DFIG and its various topologies for standalone and grid interfaced mode, DFIG with active filter capabilities was noteworthy. The talk provided deep insights of the recent trends in the aforesaid technology to the participants.

The second session was on the new National Education Policy as proposed by Govt of India The discussion was carried out by none other than the Professor and Head of Department of Higher &

Professional Education National Institute of Educational Planning and Administration (NIEPA), New Delhi, Prof. Shudanshu Bhusan.

Prof. Bhushan specializes in Internationalisation of Higher Education, Policy issues in Higher Education and Educational Planning. His present responsibility is to conduct and guide research and to provide policy support to the Government. His recent contributions include Quality Assurance of Transnational Higher Education: Australia and India Experiences, Public Financing and Deregulated

Fees in Indian Higher Education, and Restructuring Higher Education in India are noteworthy. Also he is the co-editor of a book on Teaching and Learning in Higher Education in India and Australia to be published by Routledge in 2018. His book on the Future of Higher Education in India is under publication by Springer.

With this background, he spoke on on the need of NEP -2020 for professional courses in India especially when India has emerged as leader in different sectors. The need of the hour requires a complete paradigm shift in the way the professional courses like Engineering education is taught by keeping in mind the social, economic and cultural diversities and needs in mind. He discussed the challenges for students, teachers, institutes and university for implementation of NEP 2020.

The last session of day three of the workshop was about “Adaptive Controls and its implementation in wind energy system” by Prof Dr. Ashutosh Giri , Assistant Professor, Electrical Department, Government Engineering College, Bharuch.

Dr. Giri has more than 13 years of teaching experience .He has authored and co-authored more than 40 research papers in reputed journals such as IEEE TRANSACTIONS, IET Journal, Wiley, Taylor Francis, Springer etc.

He has also co-authored one book chapter which is published in Springer Publication, and edited two books for each of CRC Press, Florida and Springer Nature Singapore. He is working on three sponsored research projects funded by GO, one of the project is in collaboration with GOG and Centre of CROM, Aalborg University, Denmark. DrGiri has delivered several keynote lectures, expert talks at more than 25 plus National and international conferences and symposia. DrGiri is also serving as a potential reviewer in various reputed journal such as IEEE TRANSACTIONS OF POWER ELECTRONICS, IEEE TRANSACTIONS ON INDUSTRIAL ELECTRONICS, IET, Wiley etc.

DrGiri is also serving as an honorary advisor (Technical Services) in GMDT Marine and Industrial Engineering Pvt. Ltd, Ahmedabad, India. He is also serving as an honorary advisor (Technical Services) in CUBATICS INDUSTRIES Pvt. Ltd, Surat. India. He is life member of Indian Society of Technical Education. Recently, he was included in Advisory Board as a member in Society of Power Engineers, Vadodara Chapter.

He discussed the present scenario and future growth of wind in India which were noteworthy. The session was highly technology intensive wherein he discussed the highly advanced power electronics-

based topologies used for grid connected and standalone wind based micro grid energy systems with adaptive control techniques.

Day session was conducted by Dr. Sanjiba Kumar Bisoyi Associate Professor Electrical Department JSS Academy of Technical Education, Noida. He spoke Energy Storage and its Application in India: Regulatory, Policy and Industrial Aspect.

Dr. Sanjiba is Ph.D. in Electrical Engineering from NIT Hamirpur (H.P). He has over 17 years of experience. He joined JSS Academy of Technical Education, Noida in the year 2003 as lecturer and became Assistant professor in 2008 and Associate Professor in 2017. Prior to academics he had around eight years of industries experience in electrical maintenance at process industries. His Field of Interest are Power Electronics, Electric Drives FACTS Devices, and Power Quality & Renewable Energy Sources. He has published more than 40 prestigious journal papers and conference.

He shared information on different energy storage devices and their future scope, customized solutions that are offered by different players in the industries. He spoke on the energy regulations and policies framed by Govt. of India for the renewable energy sources.

The next session that followed was on “Design and control of UPQC” and the talk was delivered by Dr. Sabaraj Arya, Associate Professor Electrical Department, SVNIT Surat. He has more than 24 years of teaching experience. Dr. Arya’s area of interest lies in the domain of “Power Quality- Filters, Custom Power Devices, Power Electronics Converters for Power Quality, Application of ANN and adaptive control in Power Electronics System, Distributed Power Generation System. He has received Young Engineer Award 2014 Indian National Academy of Engineering (INAE)- Delhi 2014 and POSOCO Power System Award (PPSA 2014) Power System Operation Corporation (POSOCO) –A subsidiary of Power Grid Corporation of India Ltd (POWERGRID)-Delhi in 2014 and many more. He has also authored several books with elite publishers.

Dr. Arya spoke on the various techniques and topologies of power electronic devices for improving the voltage and frequency profile of a grid. We are sure that knowledge will pave path for the new researches.

The last session of the day was on “New topologies for Solar Water Pumping Systems.” The talk was delivered by Prof. Dr. Mahmadasraf Mulla, Professor, Electrical Department SVNIT, Surat.

Dr. Mulla is a Professor at EED SVNIT, Surat and has more than 24 years of teaching experience

Dr. Mulla completed his PhD from SVNIT, Surat in 2015. Dr. Mulla's research interests are solar and wind energy conversion, digital control of power converters, power quality, and active power filters.

In a unique initiative, he has established a laboratory to teach Power Electronics, Renewable Energy, Electrical Vehicles, Power Quality, and Electrical Drives courses with hands-on based learning. He has total 75 publications at his credit, which include 02 books, 02 book chapters, 36 journal articles and 35 conference articles. He is a senior member of the IEEE, fellow of Institution of Engineers (IE) India, Fellow of the Institute of Electronics and Telecommunication Engineers (IETE), member of International Association of Engineers (IAENG), Indian Society of Technical Education (ISTE) and Asian Council of Science Editors.

Dr. Mulla spoke about exploring the solutions for feeding the energy back to the grid by the solar pumping systems especially when they are lying idle. Thank you for demonstrating some of your projects regarding the same. We are sure that these technologies will strengthen the country on energy front.

The first session of day five of the workshop began with a talk on "Three Point Model Based MPPT control of PV System." The talk was delivered by the workshop coordinator Prof Dr Hitesh Mehta.

Dr. Hitesh K Mehta received his Bachelor of Engineering in Electrical Engineering from L. E. College, Morvi. He did his M.Tech in Electrical Engineering with specialization in Power Electronics and Electrical Drives and Ph. D. from SVNIT. He joined Department of Electrical Engineering, SCET Surat as a Lecturer in 2001. Presently he is an Associate Professor at EED, SCET. He has authored and co-authored more than 15 research papers in reputed journals and conferences such as IEEE TRANSACTIONS, Elsevier, AIP, JPV Conferences etc. He is also serving as a potential reviewer in various reputed journals such as IEEE Journal of Photovoltaics, Renewable Energy Focus, Journal of Emerging and Selected Topics in Power Electronics, Applied energy etc..

The next session on day five of the workshop was on "**Introduction to dSPACE for Renewable energy Systems**" by various Engineers from DynaFusion Tech Bangalore.

DynaFusion Tech Pvt. Ltd is situated in Bangalore. It was established in the year 2009 with a mission to provide world-class solutions to the engineering community. Its specialized in engineering tools for developing and testing mechatronic control systems, DynaFusion is the most preferred development partner in the automotive industry, aerospace and industrial automation. The Company's forte lies in

working with technologies such as Modelling, Rapid Control Prototyping (RCP), ECU auto coding, Hardware-in-Loop Simulation (HILS) and Test Automation.

The session essentially included introduction and demonstration of a VFD by the engineers on implementation using dSapce.

The last session of day 5 was also a practical session, “**Design and development of battery chargers**” and it was conducted by M/s National InfoTech - A way to Power Electronics Embedded Systems Solution, Surat.

National InfoTech (NITech) is working in the field of power electronics, embedded system development and custom industrial automation. NITech comes into existence in the year of 2005 initially started with as training center in embedded system, power electronics, industrial instrumentation and automations. We have experience of more than 15 years for design and development of MCU based hardware prototypes, power electronics hardware, simulation of power electronics converters, firmware coding, product development for local market and some exposure to overseas projects. They have Expertise in Hardware Product Design PCB Layout (up to 4 layers) Prototype Manufacturing & Testing (with firmware) MCU Platforms (STM32 MCUs series, Raspberry Pi, Arduino, NRF52840, TMS320F28xx, ESP32/8266) RTOS support : Free RTOS, µcos, Linux Advanced Power Electronics Simulations and Circuit Design Data communication (RS485 MODBUS, MODBUS TCP, WIFI, BLE-5).

The first session of day six of the workshop conducted by Dr. Deepakkumar Fulwani, Associate Professor, Electrical Department, IIT, Jodhpur, Rajasthan. The topic of the talk was “Control Issues in DC MicroGrids.”

Dr. Fulwani is faculty member at Department of Electrical Engineering, IIT Jodhpur. He has earned Ph.D. degree from IIT Bombay in 2009 and has been serving IIT Jodhpur since 2011. He has also taught at IIT guwahati and IIT Kharagpur before joining IIT Jodhpur. Dr. Fulwani’s specialization is Control Theory and Applications of Control Theory. His research interest are Cyber Physical Systems, Electric Vehicles, Event Triggered Control Systems and Control of Micro-Grids and many more.

Dr. Fulwani has received several research grants from Nodal agencies like DST, MNRE etc. He has published his research findings in more than 70 articles in various journal and conference proceedings. He has guided more than 8+ students for doctoral studies and 14 plus post graduate students. He has received several awards like Excellence in Ph.D. Thesis work in IDP in Systems and Control at 48th



Convocation, IIT Bombay and Young Faculty Research Fellowship (YFRF) of Visvesvaraya Programme of Ministry of Electronics & Information Technology, MeitY, Govt. of India 2018. He has been Guest Associate Editor for IEEE Journal of Emerging and Selected Topics in Power Electronics for a Special Issue on Structured DC Microgrid. The Special Issue was Published in July 2017. He is an Associate Editor, IEEE Transactions on Industry Applications, since March -2019 And many more. Dr. Fulwani has taken up various consultancy projects for Micro grid based Solar power plant at Military Station Brichgunj, PLC Based controller for hydraulic press used in ceramic industries for Needhee Electronics, V V Nagar, Gujarat to name a few.

Dr. Phulwani spoke about issues and challenges on implementation of the Sliding Mode Control technique, a form of Robust Control system which can handle system uncertainties and provide robust control to the systems. We are also thankful to you for covering details of DC microgrid systems and usage of Sliding mode based controllers to handle the variations and disturbances in DC microgrid systems.

The last session of the workshop was on “Advanced Control Strategies for Grid Tied Solar PV system.” The talk was delivered by Dr. Chitti Babu, Assistant Professor, PV Research Laboratory IIITDM, Kancheepuram, Chennai.

Dr. Chitti Babu is an Assistant Professor at PV Research Laboratory IIITDM, Kancheepuram, Chennai. Before IIITDM, DrChittibabu was associated with Department of Electrical & Electronics Engineering, The University of Nottingham (U.K), Malaysia Campus, NIT Nagpur, NIT Rourkela and NIFFT Ranchi. DrChittibabu completed his PhD from NIT Rourkela in the year 2012 with specialization in Power Electronics Systems & Application, Wind and PV systems, Smart power Distribution, Power Quality, and Embedded System Design. His Research area are in the application of Power Electronics in smart distribution grids containing renewable energy sources, Design of low power photovoltaic (PV) energy system for portable applications including MPPT algorithm and Control and Grid Integration of Renewable power generation System. DrChittibabu was selected as an "Early Career Advisory Board Member of Control Engineering Practice" (I.F:3.4, Q1), Elsevier, March 2021. He received Teaching Quality Award, from faculty of engineering, The University of Nottingham (U.K), Malaysia Campus for the year 2016-17. Also he is Recipient of Post-Doc. Research fellowship from VSB-Technical University of Ostrava, Czech Republic, also STRONG-TiES/European Union Project, City University London and many more. He is Associate Editor of prestigious journals like IET Renewable Power Generation, IET Power Electronics, IET Energy Systems Integration, IEEE Access, Intr. Trans. on Electrical Energy Systems, John-Wiley,

AUTOMATIKA, Taylor & Francis, Associate Editor, Electrical Engineering, Springer and list is endless. DrChitti has published more than 5 book chapters in various books published by Elsevier, Springer and so on. DrChitti has more than 70 plus journal publications.

DrChittishared his knowledge and research work on the various advanced control techniques and topologies for grid connected Solar PV connected systems. It was indeed very useful for all the attendees.

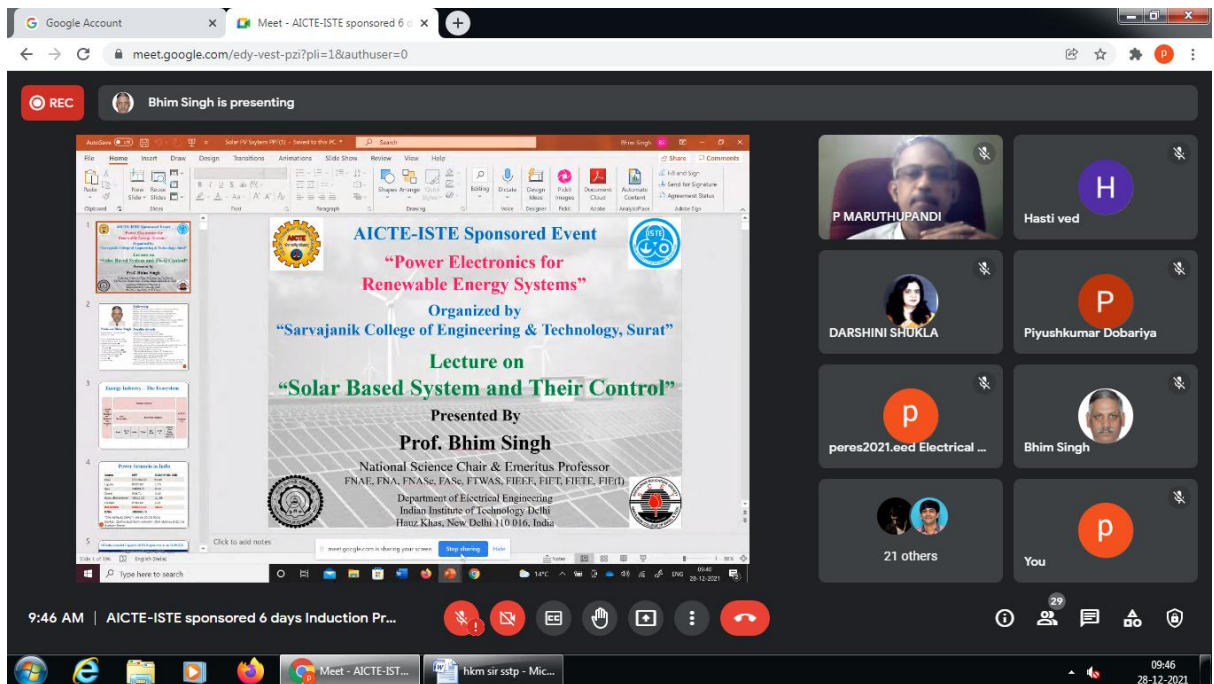
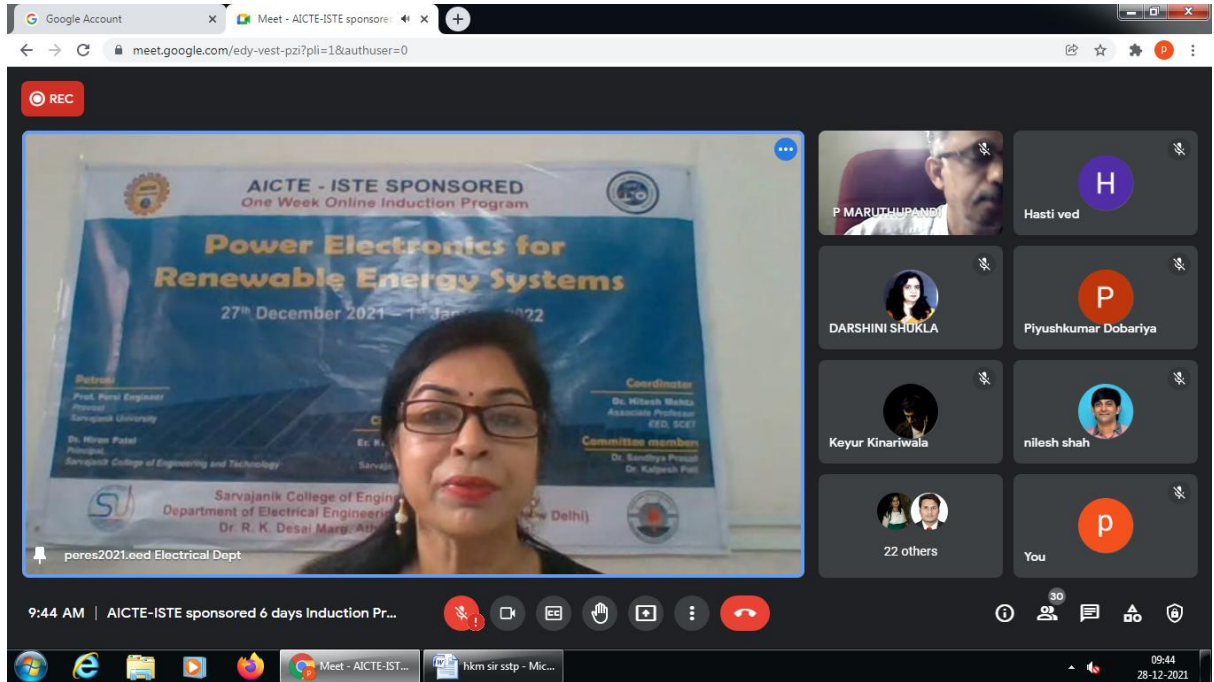
The workshop concluded with the valedictory session wherein various participants shared their feedbacks. As per their feedback, it was indeed very informative and insightful.

Furthermore, based on short daily quizzes, one final quiz and attendance, certificates were generated and sent to the respective participants in stipulated time.

The workshop served its purpose by creating awareness, empowering the research scholars by the experts from various arenas of renewable energy and power electronics and paving way for future researches and innovations.

## EVENT PHOTOGRAPH


28/12/21



Google Account x Meet - AICTE-ISTE sponsored 6 days Induction Pr... x

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REC Bhim Singh is presenting



Bhim Singh

9:46 AM | AICTE-ISTE sponsored 6 days Induction Pr...

Participants:

- P MARUTHUPANDI
- peres2021.eed Electrical ...
- Hasti ved
- DARSHINI SHUKLA
- Piyushkumar Dobariya
- archana tahlilani (outside Sarvajani College of Engineering & Technology) joined

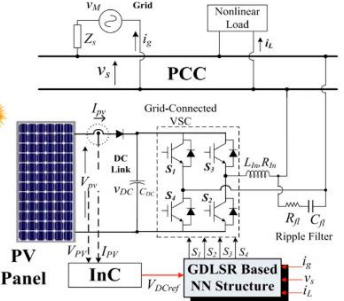
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REC Bhim Singh is presenting

### Single-Phase Single-Stage Grid Tied SPV System



System Configuration

N. Kumar, B. Singh and B. K. Panigrahi, "Framework of Gradient Descent Least Squares Regression-Based NN Structure for Power Quality Improvement in PV-Integrated Low-Voltage Weak Grid System," *IEEE Transactions on Industrial Electronics*, vol. 66, no. 12, pp. 9724-9733, Dec. 2019.

Participants:

- Bhim Singh
- peres2021.eed Electrical ...
- P MARUTHUPANDI
- Hasti ved
- DARSHINI SHUKLA
- Mayur Ghori
- 33 others
- You


10:32 AM | AICTE-ISTE sponsored 6 days Induction P...

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REC Bhim Singh is presenting



Renewable Energy Systems  
27<sup>th</sup> December 2021 – 1<sup>st</sup> January 2022

**Patron:**  
Prof. Pankaj Engineer  
Principal  
Savitribai Phule University  
Vastana, Pune

**Coordinator:**  
Dr. Himanshu Mehta  
Associate Professor  
IED, SJCE

**Committee member:**  
Dr. Samirya Prasad  
Dr. Rajesh Patel

Sarvagani College of Engineering  
Department of Electrical Engineering  
Dr. R. K. Desai Marg, Atha (Delhi)

peres2021.eod Electrical Dept

11:02 AM | AICTE-ISTE sponsored 6 days Induction P...

39 participants

11:02 28-12-2021

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REC Bhim Singh is presenting



Wind Energy Conversion Systems

Wind is Air in Motion

12/28/2021 Prof. Bhim Singh, IIT Delhi 9

11:41 AM | AICTE-ISTE sponsored 6 days Induction Pr...

21 participants

11:41 28-12-2021



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REC Bhim Singh is presenting

### Overview of Wind Energy in India

- India's wind energy sector is led by indigenous wind power industry and has shown consistent progress
- Expansion of the wind industry has resulted in a strong ecosystem, project operation capabilities and manufacturing base of about 10,000 MW per annum
- India currently has the 4th highest wind installed capacity in the world with total installed capacity of 35.6 GW (as on 31st March 2019) and has generated around 52.66 Billion Units during 2017-18

Source: <https://mewa.gov.in/wind/current-status/>

12/28/2021 Prof. Bhim Singh, IIT Delhi 15

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Meet attendance - (...).csv Show all

11:54 28-12-2021

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REC Bhim Singh is presenting

### Wind Farms in India

#### Muppandal Wind Farm, Tamil Nadu : 1,500 MW



- The country's largest onshore wind farm. The project features a large number of wind turbines (3000 turbines) of varying sizes from 200 KW to 1650 KW
- Developed by the state-owned Tamil Nadu Energy Development Agency, the facility uses wind from the Arabian Sea to generate renewable energy for nearby residents and contributes to India's overall energy mix
- Onshore wind farm
- The wind farm features turbines from several manufacturers including Suzlon, NEG Micon, Vestas, and Enercon

Source: <https://www.asenergybusiness.com/features/top-wind-power-farms-india/>

12/28/2021 Prof. Bhim Singh, IIT Delhi 40


12:04 PM | AICTE-ISTE sponsored 6 days Induction P...

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Kavish Shah is presenting



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2:15 PM | AICTE-ISTE sponsored 6 days Induction Pr...

WAAREE® One with the Sun  
ADVANCED SOLAR PV MODULE TECHNOLOGIES –  
THE EXPECTED SHIFT & WAAREE OFFERINGS

Samir Trivedi

priyank shah

Mayur Ghori

bhavin trivedi

CHEKURI MURALI


bhavin trivedi (outside Sarvajani College of Engineering & Technology) joined

14:15 28-12-2021

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Kavish Shah is presenting



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Samir Trivedi

priyank shah

Lavanya A

bhavin trivedi

CHEKURI MURALI

Lavanya A (outside Sarvajani College of Engineering & Technology) joined

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14:16 28-12-2021

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REC Kavish Shah is presenting

## WORLD CLASS TESTING FACILITY





3 Times IEC Certified Modules IEC CB-CTF APPROVED LAB Intertek

IEC CB-CTF Certified State of the Art Laboratory for Reliability Testing & Certification

The combined expertise of our people and the stringent internal & external tests on solar modules leads to reliability, Worldwide acceptance and bankability

Dynamic mechanical load test Robustness Of Termination Test Hail Impact Test Humidity Freeze test & Thermal cycling test

UV test Damp heat test PID Test Salt Mist Corrosion Test

2:24 PM | AICTE-ISTE sponsored 6 days Induction Pr...

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14:24 28-12-2021












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REC Kavish Shah is presenting

## CERTIFICATION AND THIRD PARTY AUDITS




### CERTIFICATIONS


### 3rd PARTY AUDITS

### SYSTEM CERTIFICATIONS

### 3rd PARTY INSURANCE



Waarre offers Insurance on Warranties through our Warranty partner ICICI Lombard and Munich RE

IEC 61215:2015 & IEC 61730-1&2:2015 • IEC 60068-2-28 • IEC 62804 • IEC 61701  
IEC 62715 • IEC 61215 Ed2 • IEC 61853 • IEC 62782 • IEC 62758-1\* • UL 61730-1&2  
IS 14286 • IS/IEC 61730-1 & 2 • ISO 9001:2015 • ISO 14001:2015 • ISO 45001:2018

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REC Kavish Shah is presenting

WAAREE FLEX.  
MODULES

2:36 PM | AICTE-ISTE sponsored 6 days Induction Pr...

14:36  
28-12-2021

29/12/21

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REC Dr. Swami Naidu, Assistant Professor Dept. of Electrical Engg., IIT (BHU) is presenting

Experimental Implementation of Doubly Fed  
Induction Generator for wind Energy  
Conversion System

Dr. N K Swami Naidu  
Assistant Professor,  
Electrical Engineering Department,  
IIT (BHU), Varanasi.

CELEBRATING CENTENARY  
100 years  
IIT (BHU) VARANASI

9:38 AM | AICTE-ISTE sponsored 6 days Induction Pr...

09:38  
29-12-2021

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REC Dr. Swami Naidu, Assistant Professor Dept. of Electrical Engg., IIT (BHU) is presenting

**AICTE - ISTE SPONSORED**  
One Week Online Induction Program

**Power Electronics for Renewable Energy Systems**  
27th December 2020

**Patron:**  
Prof. Pankaj Engineer  
(Principal)  
Sardar Vallabhbhai Patel  
Sardar Vallabhbhai College of Engineering and Technology

**Coordinator:**  
Dr. Nilesh Mishra  
Associate Professor  
EED, SCET

**Committee member:**  
Dr. Sandhya Prasad  
Dr. Rajesh Patel

Sarvajani College of Engineering  
Department of Electrical Engineering  
Dr. R. K. Deshpande

peres2021.eed Electrical Dept

9:39 AM | AICTE-ISTE sponsored 6 days Induction Pr...

peres2021.eed Electrical ... JIGNESH DESAI Samir Trivedi Jagdish Dholwani 12 others You

09:39 29-12-2021

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REC Dr. Swami Naidu, Assistant Professor Dept. of Electrical Engg., IIT (BHU) is presenting

**Wind Energy Conversion System**

Blade Pitch Drive Rotor Hub Rotor Bearings Mechanical Control System

Main Shaft (Low Speed) Multi-Stage Gearbox Mechanical Brake (On High Speed Shaft) Wind Generator Power Electronic Converter Wind Measurement Nacelle Nacelle Frame Ladder Three Phase Cable Tower Step-Up Transformer

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### DFIG Wind Energy System

#### System Configuration

DFIG system

- Variable speed range: 70% to 130% of synchronous speed
- Gearbox
- Bidirectional back-to-back converter
- Maximum market share (currently)

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EED, SCEI

**Committee members:**  
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Dr. Kalyanesh Puri

**Dr. Miran Patel**  
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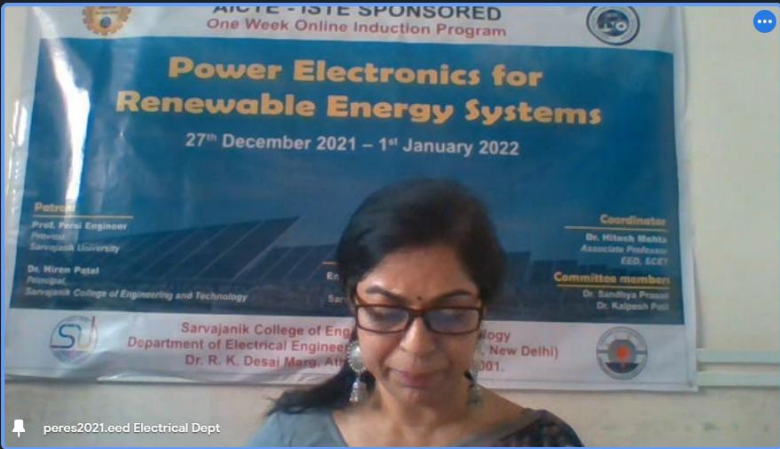
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**Advanced Control Strategies for Grid-tied Solar PV System**



**B.Chitti Babu Ph.D., SMIEEE**  
Photovoltaic(PV) Research Lab  
IIITD&M Kancheepuram, Chennai  
E-mail: bcbabu@iiitdm.ac.in

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## Renewable Energy In India

- India is one of the countries with large production of energy from renewable sources.
- As of 30 Sep 2020, 36.17% of total installed capacity is from renewable energy sources (135,000 MW out of 373,000 MW).
- Target: 57% of total installed capacity from RESs by 2027 according to CEA, India.

Indian renewable energy sector is the fourth most attractive renewable energy market in the world. India is ranked fourth in wind power, fifth in solar power and fifth in renewable power installed capacity as of 2018. *According to Renewable Energy Country Attractiveness index 2018 by EY.*

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## Installed Renewable Power Capacity

Source	Total Installed Capacity (MW)	2022 target (MW)
Wind power	38,124.15	60,000
Solar power	36,050.74	100,000
Biomass power (Biomass & Gasification and Bagasse Cogeneration)	10,145.92	*10,000
Waste-to-Power	168.64	
Small hydropower	4,739.97	5,000
<b>TOTAL</b>	<b>89,229.42</b>	<b>175,000</b>

Solar power in India is a fast developing industry. The country's solar installed capacity was 44,300 MW as of 31 August 2021.

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Background

### Institutional Framework Contd...

Central Govt.

State Govt.

Trading Co.

State Sector

IPPs

Appellate Tribunal

CERC

SERC

Authorities

R&D

UMPPs

IPTCs

Central Electricity Regulatory Commission (CERC)

State Electricity Regulatory Commissions (SERCs)

Central Electricity Generating Corporation (CEGC)

Central Electricity Transmission Corporation (CETC)

Central Electricity Distribution Corporation (CEDC)

Central Electricity Generating Stations (CEGS)

State Electricity Generating Companies (SEGENs)

Central Electricity Transmission Lines (CETLs)

State Electricity Transmission Lines (SETLs)

Central Electricity Distribution Lines (CEDLs)

State Electricity Distribution Lines (SEDLs)

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Application of Energy Storage

Where can energy storage systems (ESS) generate value?  
Applications can range from ancillary services to grid operators to reducing costs "behind the meter" to end users

Applications for Grid Operators and Utilities

- ☐ Energy Arbitrage
- ☐ Flexible Peaking Resource/Resource Adequacy
- ☐ Frequency Regulation
- ☐ Reserve Capacity (Spin/Non-Spin)
- ☐ Voltage Support
- ☐ Black Start
- ☐ Transmission & Distribution Deferral

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Application of Energy Storage

Where can energy storage systems (ESS) generate value?  
Applications can range from ancillary services to grid operators to reducing costs "behind the meter" to end users

Applications for Grid Operators and Utilities

- ☐ Energy Arbitrage
- ☐ Flexible Peaking Resource/Resource Adequacy
- ☐ Frequency Regulation
- ☐ Reserve Capacity (Spin/Non-Spin)
- ☐ Voltage Support
- ☐ Black Start
- ☐ Transmission Congestion Relief

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### Introduction

- The demand for large amount of power for industrial and domestic use increased the burden on the generation. Electrical utilities working today are working as a subsystem of a large utility network that are tied together in order to form a complex grid. All these factors have put the power system under the requirement of a power quality [1-8].
- The modern electrical distribution system is highly vulnerable to the different power quality problems [1-15]. The excessive use of nonlinear devices in power system such as power electronic devices and equipment, traction system, fluorescent lights, arc furnaces, highly inductive loads like induction machines and air conditioning units are causing poor quality problems [2-5].
- The non-linear load creates harmonic current and then starts flowing across the line and source impedance and this causes distortion of voltages, excessive power loss and voltage drop. As the supply voltage gets distorted it leads to mal-operation of protection, control, and the metering equipment. So, the necessity for maintenance of the power quality standards arises and to achieve a voltage that will be purely sinusoidal [15].
- The group of devices used in the distribution system for power quality improvement is known as Custom Power Device (CPD). These CPD include the DSTATCOM (Distribution STATic COMpensator), DVR (Dynamic Voltage Restorer) and UPQC (Unified Power Quality Conditioner). Detail study of these devices has been reported in the literature [24-36].
- The UPQC, a combination of shunt and series compensators is recommended in the literature [36-40] as a single solution for mitigating multiple PQ problems of voltages and currents. Its shunt VSC provides reactive power compensation along with load balancing, neutral current compensation, and elimination of harmonics while series VSC keeps the load end voltage balanced irrespective of the voltage sag/swell, surges, spikes, notches, voltage unbalance and etc.

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Unified Power Quality Conditioner (UPQC)

b) Three phase four wire VSC based UPQC

Figure 3.3 Three phase four wire VSC based UPQC topology for adaptive control methods

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Power Electronics for Renewable Energy Systems

27<sup>th</sup> December 2021 – 1<sup>st</sup> January 2022

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Coordinator: Dr. Hitesh Mehta, Associate Professor, ESD, SCET

Committee member: Dr. Samirya Prasad, Dr. Kulprekash Patel

Dr. Hiren Patel, Principal, Sarvagani College of Engineering and Technology

Sarvagani College of Engineering and Technology, Department of Electrical Engineering, New Delhi

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REC Mahmadarraf Mulla is presenting

### Outline

- Motivation of Renewable Energy Sources
- Motivation of Solar Energy Study
- Motivation of Solar Water Pumping Systems
- Issues and Opportunities
- New Topologies Proposed
  - [I] Multipurpose Battery-assisted SPVWPS
  - [II] Grid-interactive Two-stage SPVWPS
    - Results and Discussion
  - [III] Grid-interactive Single-stage SPVWPS
  - [IV] Grid-assisted AC-bus Interfaced SPVWPS
  - [V] Grid-assisted DC-bus Interfaced SPVWPS
- Summary

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REC Mahmasraf Mulla is presenting

### Motivation to Study Pumping System

- Government launched **PM-KUSUM** (Pradhan Mantri Kisan Urja Suraksha evam Utthaan Mahabhiyan) Scheme for farmers to provide
  - energy and water security;
  - de-densify the farm sector; and
  - generate additional income for farmers by producing solar power.

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### TPM PARAMETERIZATION UNDER ENVIRONMENTAL VARIATIONS

The data-sheet information is considered as the reference values, namely, the SC current ( $I_{SCref}$ ), the OC voltage ( $V_{OCref}$ ), the voltage and current at MPP ( $V_{MPref}$ ,  $I_{MPref}$ ). These quantities are adjusted for different irradiance ( $G$ ) and temperature ( $T$ ) using STC ( $G_{ref} = 1 \text{ kW/m}^2$  and  $T_{ref} = 25^\circ\text{C}$ ) as per following eq. [2.21]-[2.24]

$$I_{SC}(G, T) = I_{SCref} \frac{G}{G_{ref}} [1 + \alpha(T - T_{ref})] \quad [2.21]$$

$$I_{MP}(G, T) = I_{MPref} \frac{G}{G_{ref}} [1 + \alpha(T - T_{ref})] \quad [2.22]$$

$$V_{OC}(G, T) = V_{OCref} \left[ 1 + \beta(T - T_{ref}) + \frac{N_s n k T}{q} \log \left( \frac{G}{G_{ref}} \right) \right] \quad [2.23]$$

$$V_{MP}(G, T) = V_{MPref} \left[ 1 + \beta(T - T_{ref}) + \frac{N_s n k T}{q} \log \left( \frac{G}{G_{ref}} \right) \right] \quad [2.24]$$

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### PROPOSED TPM MPPT ALGORITHM

The detailed flowchart of proposed algorithm is shown in Figure 4.1 & 4.2.

**Figure 4-1 The TPMMPPT algorithm flowchart for PV module system in uniform irradiance**

**Figure 4-2 The TPMMPPT algorithm flowchart for PV array under uniform and non-uniform conditions**

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## THE TPM MPPT OF PV MODULE IN STEADY-STATE AND DYNAMIC CONDITIONS

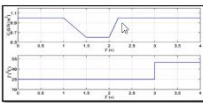


Figure 4-4 Different variations in irradiance (G) and temperature (T) for simulation study

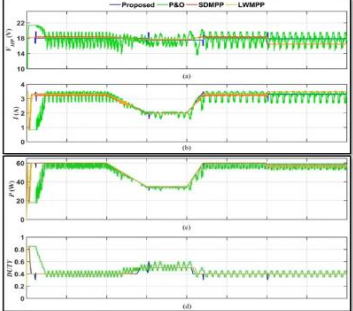


Figure 4-5 Simulation results of proposed, P&O, SDMP and LWMPP algorithms for (a)  $P_{MP}$  (2)  $P$  (3)  $I$  and (d) duty cycle

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Mr. Bilwagunda Padil  
Mr. Sagar Chakraborty  
Dynamilis Technology Pvt. Ltd.  
Amandeep Singh (Pr...



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### Agenda

**DynaFusion**  
Your dSPACE Partner in India

- V-Cycle (Controller Development Procedure)
- RCP (Rapid Control Prototyping)
- dSPACE Hardware's
- dSPACE Software's
- DS1104
- MicroLabBox
- New era ACEKit
- Advantages of dSPACE - Academics
- References

DynaFusion - Confidential 3

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### V-Cycle

**DynaFusion**  
Your dSPACE Partner in India

The diagram illustrates the V-Cycle process. At the top, 'Control Design and Offline Simulation' is represented by a circuit board icon. This leads to a central 'V' shape. The left side of the 'V' is labeled 'Rapid Control Prototyping' and features an image of a dSPACE hardware unit. The right side of the 'V' shows a laptop icon. At the bottom of the 'V', there is a red icon representing a final output or deployment. The entire process is enclosed in a light blue trapezoidal frame.

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One Week Online Induction Program

# Power Electronics for Renewable Energy Systems

27<sup>th</sup> December 2021 - 3<sup>rd</sup> January 2022

**Patron:**  
Prof. Pankaj Engineer  
Principal,  
Savitribai Phule  
Pune University

**Coordinator:**  
Dr. Hiran Patel  
Associate Professor  
EED, SCET

**Committee member:**  
Dr. Sandhya Prasad  
Dr. Kalpana Patil

Savitribai Phule  
Department of Electrical Engineering  
Dr. R. K. Desai

peres2021.eed Electrical Dept

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Deepak Fulwani is presenting

10:17 AM Sat 1 Jan

What is the advantage?

- Consider a n-th order system represented in the phase variable form

$$\begin{cases} \dot{x}_1 = x_2 \\ \dot{x}_2 = x_3 \\ \vdots \\ \dot{x}_{n-1} = x_n \\ \dot{x}_n = -a_1 x_1 - a_2 x_2 - \dots - a_{n-1} x_{n-1} + b u \end{cases}$$

Also consider the sliding surface defined as

$$s = c^T x = c_1 x_1 + c_2 x_2 + \dots + c_{n-1} x_{n-1} + x_n = 0$$

$$\Rightarrow \dot{x}_n = -c_1 x_1 - c_2 x_2 - \dots - c_{n-1} x_{n-1} - \dot{x}_n$$

$$\Rightarrow \dot{x}_n = -c_1 x_1 - c_2 x_2 - \dots - c_{n-1} x_{n-1} - (-c_1 x_1 - c_2 x_2 - \dots - c_{n-1} x_{n-1} + b u)$$

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REC Ashutosh Giri is presenting

REC
A Ashutosh Giri is presenting

## Wind Energy based DG System Design

- Turbine design
- Induction generator design
- Interfacing inductor design
- Design of VSC
- Design of Transformer
- Battery backup Requirement

Dr.A.K.Giri, Electrical D.  
BHARUCH

p

You

Ashutosh Giri

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25 others

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- Power rating of the single phase generator: 2238 watt (3 h.p) and efficiency is 85%
- Mechanical input required at generator:  $2238/0.85 = 2632$  watt
- Assuming 10% mechanical loss in gear boxes etc, turbine output power =  $2632 + 2632 * 10/100 = 2895$  watt  $\approx 3000$  watt
- From equation (3.1), radius of swept area ( $R$ ) can be obtained with known values of  $\omega$ , and  $v_w$ . Here these are taken as 0.48, 1.12 and 12 m/s respectively.  $R$  is equal to 1.434 m.

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A.K.Giri(D16EL006) Guided by Dr. S.R.Arya and Dr. R.K.Majumdar, SVNIT, Surat

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