

Department of Electrical & Electronics Engineering

AICTE sponsored six days online Short Term Training Programme (STTP)

On

“ELECTRIC VEHICLE EVOLUTION - IMPACT ON POWER GRID”

Phase-I: February 8th to 13th 2021 Phase-II: March 22nd to 27th 2021

Phase-III: April 19th to 24th 2021

Chief Patron

Dr. M. Sivanandham, Secretary, SVEHT

Patron

Dr. S. Ganesh Vaidyanathan, Principal

Convener

Dr. KR. Santha, Vice-Principal

Coordinators

Dr. KR. Santha, Professor & Head / Dept. of EEE

Dr. S. G. Bharathidasan, Asso. Professor/EEE

Dr. M. Sankar, Asst. Professor/EEE

Mr. S. Kumaravel, Asst. Professor/EEE

Mr. S. S. Sethuraman, Asst. Professor/EEE

Mr. S. Thamizmani, Asst. Professor//EEE

ABOUT THE INSTITUTION

Sri Venkateswara College of Engineering (SVCE), a premier self-financing Engineering College was started in the year 1985 and is managed by Sri Venkateswara Educational and Health Trust. The college conducts 11 B.E / B.Tech Degree Courses and 8 PG Courses in Engineering. The college has 11 Research Centers approved by Anna University cater to MS (by Research) and PhD programmes. The courses are approved by AICTE and affiliated to Anna University, Chennai. The college received Autonomous status in 2016. The college is accredited by National Assessment and Accreditation Council (NAAC). The college is situated in serene environment about 37 km from Chennai and situated on the way of Chennai – Bangalore National Highway (NH4) at Pennalur, Sriperumbudur, in Kanchipuram district.

ABOUT THE DEPARTMENT

The Department of EEE was started in the year 1994. The post graduate program (M.E) in Power Electronics and Drives was started in 2002. The department has secured permanent affiliation with Anna University and accredited by National Board of Accreditation (NBA) for the third consecutive time of Full Accreditation for five years. The Department has well equipped state-of-the-art laboratories and recognized as a Research Centre by Anna University. The Department has well qualified and experienced faculty and staff of proven ability and profound skills.

ABOUT THE STTP

The future Electrical Power System operation and control has to be restructured to face the challenges of plug-in Electric Vehicles (EV) evolution. The knowledge in EV drive, Battery Energy Storage (BES), Fast-charging circuitry, Battery Management System (BMS) and its impact on smart and micro grid dynamics, coordinated BMS, control, protection and communication protocols are imperative for Engineers working in these domains. This STTP is aimed at training the participants on the present procedures and future expectations in the aforementioned areas by experts from Industry & Institutions. This STTP will also facilitate the participants to acquire hands-on training in this field through various related systems modeling and simulation. After attending workshop, Participants will be able to select and design suitable motors, Battery management system and power converters for Electric Vehicles. They can also identify the changes to be done in Power System after EV incorporation in Micro and Smart grid environments.

OBJECTIVES

- ❖ Familiarize the participants about EV configuration/ components and its interaction with power grid.
- ❖ Creating awareness on impact of EV evolution on operation and control of Electrical Power System.
- ❖ Inculcate charging/discharging of aggregated EV and its impact on micro grid.
- ❖ Training the delegates in design and analysis of EV drive motor using MAGNET, simulation of EV with battery energy storage (BES) using PWSIM, MATLAB and DIgSILENT.
- ❖ Offering expertise to the participants on operation of micro and smart grids with EV.

STTP TOPICS

- ❖ EV evolution - Challenges to Power System Operation and Control - Utility Preparedness
- ❖ Configuration and components of EV-Overview
- ❖ EV drive motor design aspects - Hands on session using MAGNET software
- ❖ Electric Vehicle Charging Station Requirements and Battery Management Systems (BMS)
- ❖ Battery Energy Storage Technologies for Electric Vehicle and Issues in Integration with Power Grid
- ❖ Electric Vehicle and Power System Operation and Control - a perspective
- ❖ Coordination of multiple EVs, Renewable Energy Sources and Battery Energy Storage Systems in Smart Grid
- ❖ Impact of EV Evolution on Electrical Power System Dynamics
- ❖ Design and implementation of controllers and control strategies for Electric Vehicle
- ❖ Electric Vehicle add-on micro-grid - Protection studies
- ❖ Hands on Training on Micro/Smart grid Power System using DIgSILENT
- ❖ Smart Grid controls - Operation and Control with Electric Vehicle
- ❖ Electric Vehicle – Future perspectives and preparedness
- ❖ Hands on Training to realize the impact of Electric Vehicle on Power System Dynamics

INDUSTRY RESOURCE PERSONS

Mr.S.Sankara Narayanan, General Manager, Tamilnadu Energy Development Agency, Govt. of Tamilnadu
Mr.S.Jayakrishnan, General Manager, Hyundai Motor India Ltd
Dr.R.Kathiravan, AEE, TANGEDCO, TNEB
Dr.S.Sudhakar, Senior Scientist, CSIR - Central Electrochemical Research Institute, Karaikudi
Dr.N.Sivakumar, Global Technical lead, Rolls-Royce, Singapore.
Mr.Nandhakumar, Design Engineer, Power Grid Corporation of India.
Dr.B.Chandra Sekhar, Technical Lead, TCS, Bangalore.
Mr.B.Saravanan, Lead-Traction control, Alstom, Bangalore.
Dr.A.Deepak, EM Design Engineer, ePropelled systems Pvt Ltd.
Dr.V.P. Boopathi, Sr. Appn. Engineer, PWSIM Engg. Solns Pvt Ltd.
Mr.Balasubramanian Ananthraman, Scientist, CSIR - Central Electrochemical Research Institute, Chennai

ACADEMIC RESOURCE PERSONS

Dr.K.Shanti Swarup, Professor, Indian Institute of Technology Madras.
Dr. R.Jayashri, Professor, School of Electrical Engineering and Telecommunications, UNSW SYDNEY, AUSTRALIA.
Dr.R.P.Kumudinidevi, Professor, EEE Dept, Anna University Chennai.
Dr.D.Kalpana, Asst. Prof., Dept. of Instrumentation Engg, Madras Institute of Technology.
Dr.S.Kumaravel, Asso. Prof., EEE Dept., National Institute of Technology, Calicut.
Dr.P.Raja, Asso. Prof., EEE Dept., National Institute of Technology, Tiruchirappalli.
Dr.V.Gomathi, Asso. Prof., EEE Dept, Anna University, Chennai.
Dr.C.Christober Asir Rajan, Professor, EEE Dept , Pondicherry Engineering College.
Dr.D.Maharajan, Asso. Prof., EEE Dept., SRM University
Dr.V.Saravanan, Professor, EEE Dept., AEC.

ADVISORY COMMITTEE

Dr.N.K.Mohanty, Professor
Dr.Sudhakar K Bharatan, Professor
Dr.R.Karthikeyan, Asso. Professor
Dr.C.Gopinath, Asso. Professor

ORGANIZING COMMITTEE

Ms. S.Arulmozhi AP/EEE
Ms.M.Sasikala AP/EEE
Ms. N.Shanmugavadivu AP/EEE
Mr.C.Venkatesan AP/EEE
Ms.K.Suganthi AP/EEE
Mr.S.Sudharsanam AP/EEE
Dr.T.Annamalai AP/EEE

Ms.D.Amudhavalli AP/EEE
Mr.M.Ranjithkumar AP/EEE
Mr.D.S.Purushothaman AP/EEE
Ms.S.Anitha AP/EEE
Ms.S.Sinthamani AP/EEE
Ms.K.S.Pavithra AP/EEE
Mr.V.Mohanraj AP/EEE

Mr.G.Vinoth kumar AP/EEE
Ms.M.Rajalakshmi AP/EEE
Mr.C.Kamal AP/EEE
Ms.M.Maadhuri AP/EEE
Dr.R.Kannadasan AP/EEE

ELIGIBILITY

This AICTE sponsored STTP is open to Faculty members of AICTE approved Institutions, Research scholars and persons from Industries from all over the country. As per AICTE guidelines no registration fee will be charged from the participants.

Registration link: <https://forms.gle/cEdKcypoasR51xM18>

Scan QR Code



CERTIFICATE

A test shall be conducted by Project Monitoring Committee (PMC) at the end of the STTP and the certificates shall be issued to those participants who have attended all the sessions of the STTP and have qualified in the test. The number of participants will be limited to 100 for each Phase. Online meeting link will be sent to Whatsapp contact /Registered email. [For any queries: svceesttp2021@gmail.com](mailto:svceesttp2021@gmail.com)

ADDRESS FOR COMMUNICATION

The Co-ordinator,
AICTE-EEE-STTP,
Department of Electrical and Electronics Engineering,
Sri Venkateswara College of Engineering,
Irungattukottai post, Pennalur,
Sriperumbudur Taluk, Tamilnadu-602 117,
Ph.No: 044-27152000 Ext.:251,
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Report
of
AICTE sponsored Online Short Term Training Programme
on

**“ELECTRIC VEHICLE EVOLUTION –
IMPACT ON POWER GRID”**

Phase-I: February 8th to 13th 2021 Phase-II: March 22nd to 27th 2021

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ACKNOWLEDGEMENT

We thank All India Council for Technical Education (AICTE) for granting fund of Rs.316667/- (Rupees Three Lakh Sixteen Thousand Six Hundred and Sixty seven only) for this conduct of Short Term Training Program (STTP).

We thank Dr.A.C. Muthiah, Chairman, Sri Venkateswara Educational and Health Trust, Prof. Muthukumaran Sivanandham, Secretary, Sri Venkateswara Educational and Health Trust and Dr.S.Ganesh Vaidyanathan, Principal, Sri Venkateswara College of Engineering for facilitating us with this opportunity.

We thank the expert speakers from industry and academia for accepting our invite and sharing their valuable expertise with the participants.

We thank the participants from industry and academia for their enthusiastic participation and overwhelming feedback.

We thank all the faculty members involved in day-to-day activities of pre-event, during the event and post-event proceedings of the STTP.

Dr. KR. Santha
Vice-Principal
Professor and Head / EEE
Convener & Coordinator
Sri Venkateswara College of Engineering

&

Co-coordinators

ORGANIZING COMMITTEE

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Mr. S. Thamizmani, Asst. Professor/EEE

ABSTRACT

The future Electrical Power System operation and control has to be restructured to face the challenges of plug-in Electric Vehicles (EV) evolution. The knowledge in EV drive, Battery Energy Storage (BES), Fast-charging circuitry, Battery Management System (BMS) and its impact on smart and micro grid dynamics, coordinated BMS, control, protection and communication protocols are imperative for Engineers working in these domains. This STTP was aimed at training the participants on the present procedures and future expectations in the aforementioned areas by experts from Industry & Institutions. This STTP also facilitated the participants to acquire hands-on training in this field through various related systems modeling and simulation. After participating in this STTP, participants gained the expertise to select and design suitable motors, Battery management system and power converters for Electric Vehicles. They also gained expertise in identifying the changes to be done in Power System after EV incorporation in Micro and Smart grid environments.

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- ❖ Offering expertise to the participants on operation of micro and smart grids with EV.

EXPERT SPEAKERS

Industry Experts:

Dr.S.Sankara Narayanan,

General Manager, Tamilnadu Energy Development Agency, Govt. of Tamilnadu

Dr.C.Veeramani,

Chief Engineer (Retd), TANGEDCO (formerly TNEB)

Mr.S.Jayakrishnan,

General Manager, Hyundai Motor India Ltd

Dr.R.Kathiravan,

Assistant Executive Engineer, TANGEDCO

Dr.S.Sudhakar,

Senior Scientist, CSIR - Central Electrochemical Research Institute, Karaikudi

Dr.N.Sivakumar,

Global Technical lead, Rolls-Royce, Singapore.

Mr.Nandhakumar,

Design Engineer, Power Grid Corporation of India.

Dr.B.Chandra Sekhar,

Technical Lead, TCS, Bangalore.

Mr.B.Saravanan,

Lead-Traction control, Alstom, Bangalore.

Mr.Rathnakumar Devaraj,

Industrial & Systems, Development Engineer, CE+T Power, Wandre, Belgium

Dr.A.Deepak,

EM Design Engineer, ePropelled systems Pvt Ltd.

Dr.V.P. Boopathi,

Sr. Appn. Engineer, PWSIM Engg. Solns Pvt Ltd.

Mr.Balasubramanian Ananthraman,

Scientist, CSIR - Central Electrochemical Research Institute, Chennai

Academia Experts:

Dr.K.Shanti Swarup,

Professor, Indian Institute of Technology Madras.

Dr.R.P.Kumudinidevi,

Professor, EEE Dept, Anna University Chennai.

Dr.Sankara Narayanan,

*Professor & Head, EEE Dept., National Institute of Technology,
Tiruchirappalli*

Dr.S.Chandramohan,

Prof. & HOD/EEE Dept., Anna University, Chennai.

Dr. R.Jayashri,

*Professor, School of Electrical Engineering and Telecommunications, UNSW
SYDNEY, AUSTRALIA.*

Dr.P. Somasundaram,

Prof. EEE Dept., Anna University Chennai.

Dr K.Rathnakannan,

Asso. Prof., EEE Dept., Anna University Chennai.

Dr.D.Kalpana,

Asst. Prof., Dept. of Instrumentation Engg, Madras Institute of Technology.

Dr.S.Kumaravel,

Asso. Prof., EEE Dept., National Institute of Technology, Calicut.

Dr.P.Raja,

Asso. Prof., EEE Dept., National Institute of Technology, Tiruchirappalli.

Dr.V.Gomathi,

Asso. Prof., EEE Dept, Anna University, Chennai.

Dr.C.Christober Asir Rajan,

Professor, EEE Dept , Pondicherry Engineering College.

Dr.D.Maharajan,

Asso. Prof., EEE Dept., SRM University

Dr.V.Saravanan,

Professor, EEE Dept., Arunai Engineering College.

STTP details

The AICTE sponsored STTP on ‘Electric Vehicle Evolution – Impact on Power Grid’ was organized by the Department of Electrical and Electronics Engineering, Sri Venkateswara College of Engineering in ONLINE mode in three phases as detailed below:

Phase-1: 8th February 2021 – 13th February 2021

Phase-2: 22nd March 2021 – 27th March 2021

Phase-3: 19th April 2021 – 24th April 2021

The brochure, schedule, inaugural invite and agenda of all the three phases are given in the Annexure 1, 2 and 3 respectively.

The Phase-1 of this STTP was hosted online on 8th Feb 2021 at 9.30 AM. The STTP started with a prayer song. **Dr.KR.Santha, Vice Principal, Professor and HOD/EEE** delivered the welcome address and briefed about significance and objectives of the STTP. **Prof. Dr. S. Ganesh Vaidyanathan, Principal, Sri Venkateswara College of Engineering** delivered the presidential address.

The Phase-1 of STTP was inaugurated by **Dr.S.Sankara Narayanan, General Manager, Tamil Nadu Energy Development Agency**. The Phase-2 of STTP was inaugurated by **Er.C.Veeramani, Chief Engineer Regulatory Cell (Retd), TANGEDCO**. The Phase-3 of STTP was inaugurated by **Dr.R.Kathiravan, Executive Engineer, TANGEDCO**. Following the inaugural address the dignitaries delivered an expert lecture on the topic “Impact of Renewable Energy Generation and Electric Vehicle on Power Grid – Future perspective and Preparedness”.

In all the phases of the STTP, the participants from industry and academia were trained in the area of '**Electric Vehicle Evolution and its Impact on Power Grid**' through 18 sessions of expert lectures and hands-on by Eminent Industry and Academic experts as given in schedule (Annexure 1). 85 Participants attended Phase-1, 42 Participants attended Phase-2 and 79 Participants attended Phase-3. The participants' certificate sample is given in Annexure 5.

The valedictory of the AICTE-STTP was held on 24th April 2021 at 3.30 PM. **Dr.KR.Santha, Vice Principal, Professor and HOD/EEE** delivered the valedictory address. The valedictory invite & agenda is given in Annexure 4.

SESSION DETAILS



Welcome address by **Dr.KR.Santha**, Vice Principal, Professor and HOD/EEE



Inaugural address by **Dr.S.Sankara Narayanan**, General Manager, Tamil Nadu Energy Development Agency followed by expert lecture on the topic “Impact of Renewable Energy Generation and Electric Vehicle on Power Grid – Future perspective and Preparedness.”

Phase-1 (Day-1, 08/2/2021, Monday), Inauguration & session-1, Video link:

<https://drive.google.com/file/d/1YZpgipURtCJ-Ajo-xbs6fZUvDHmHJ4E2/view?usp=sharing>

Components of EV – Total vehicle resistance

- Each resistance can be calculated manually by a series of different equations.
- The total resistance acting on a vehicle is the sum of all the individual resistances involved.
- The general resistance equation of resistance can be given as:

$$R_t = a + bv + cv^2$$

- Here, R_t - Total resistance
- a, b & c - Coefficients of resistance
- v - Velocity of the vehicle.
- Hence we can see that the Total vehicle resistance is a function of velocity.

Experimental Procedure for calculating vehicle total resistance

Coast down test

- Coast down test is a test that can be conducted to calculate the Resistance equation.
- By conducting this test we can derive if

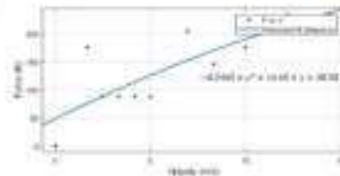


Figure 10: Graph plotted between total force and vehicle velocity



GANESH V A2T

SVCE- STTP day-1 (2021-02-07 at 21:39 GMT-8)

Reuse – Second life

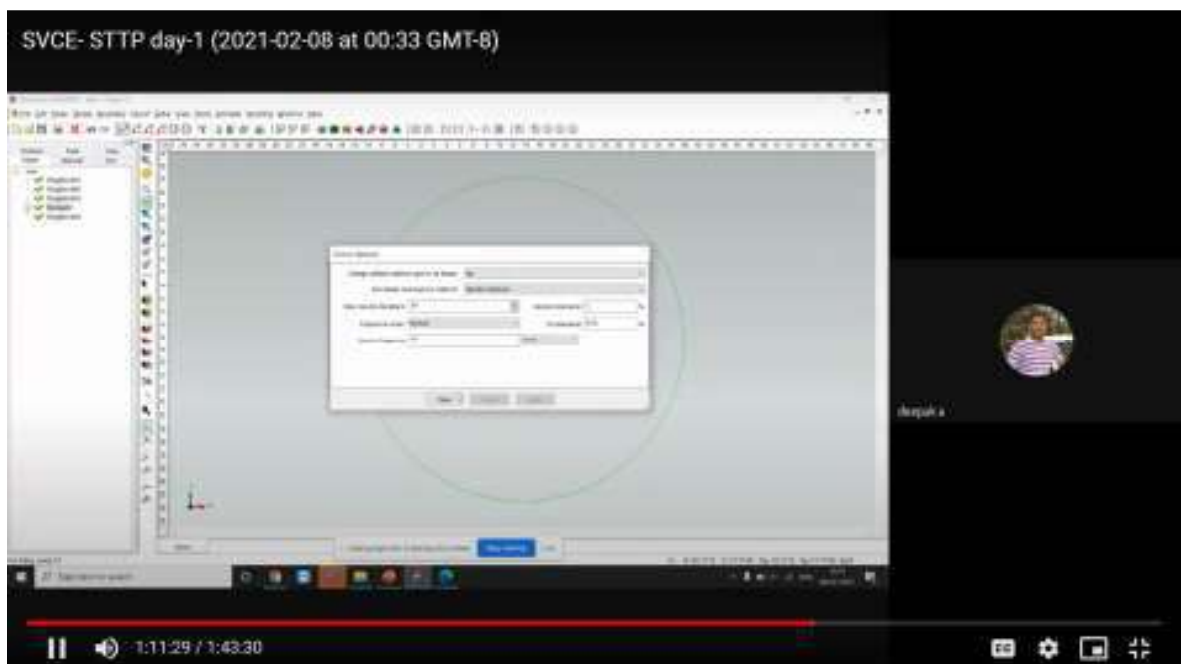


A2TECH

Phase-1 (Day-1, 08/2/2021, Monday), Session-2: Expert lecture by **Dr.V.Ganesh, ASP/DAE/SVCE** on **“Configurations and components of Electric Vehicle – Overview.”**

Phase-1 (Day-1, 08/2/2021, Monday), Session-2, Video link:

https://drive.google.com/file/d/1_GrNzJ5_xAEUcH9g_VCa5COYHL9SoS9/view?usp=sharing






Session-3: Expert lecture by **Dr.A.Deepak, EM Design Engineer, ePropelled systems Pvt Ltd.** on the topic “**EV drive motor design aspects - Hands on session using MAGNET software.**”

Phase-1 (Day-1, 08/2/2021, Monday), Session-3, Video link:

<https://drive.google.com/file/d/1dCh2Zg4UmQnFj-nDrXjn1vW1pWF1CS0f/view?usp=sharing>

SVCE-EEE-AICTE STTP: day 2 (2021-02-08 at 20:28 GMT-8)


Battery Management System (BMS) & EV Charging Station Requirements

Presented by
Dr. B. Chandra Sekhar
Technical Lead,
TATA Consultancy Services (TCS), Bangalore.

0:19 / 3:52:08

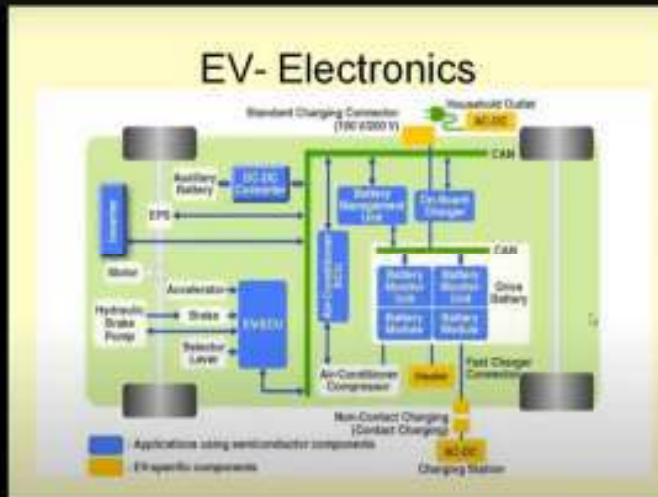
SVCE-EEE-AICTE STTP: day 2 (2021-02-08 at 20:28 GMT-8)

BMS Parameters Display on IVI Screen



31:10 / 3:52:08

Phase-1 (Day-2, 09/2/2021, Tuesday), session-1: Expert lecture by **Dr.B.Chandra Sekhar**, Technical Lead, Tata Consultancy Services, Bangalore on the topic “Electric Vehicle Charging Station Requirements and Battery Management Systems (BMS).”



1:51:45 / 3:52:08



3:13:44 / 3:52:08

Phase-1 (Day-2, 09/2/2021, Tuesday), session-2: Expert lecture by **Dr K.Rathnakannan, Asso. Prof.**
Department of EEE, College of Engineering, Guindy, Anna University, Chennai on the topic
“Design and implementation of controllers and control strategies for Electric Vehicle”

Phase-1 (Day-2, 09/2/2021, Tuesday), session-1 & 2:

<https://drive.google.com/file/d/1OiNuetib5LgIpj6hI6SISUAWTSkKOX5/view?usp=sharing>

SVCE-EEE-AICTE STTP: day 2 (2021-02-09 at 00:31 GMT-8)

1. Electrode Sheet Preparation

```

graph TD
    A[Sintering] --> B[Milling]
    B --> C[Slurry Mixing]
    C --> D[Coating]
    D --> E[Roll Pressing]
  
```

Coating Unit

Roll Press/Calendering Unit

SVCE-EEE-AICTE STTP: day 2 (2021-02-09 at 00:31 GMT-8)

S

Selvakumar Sudhakar

SVCE-EEE-AICTE STTP: day 2 (2021-02-09 at 00:31 GMT-8)

Inside View Of DRY Room



Video Link



Phase-1 (Day-2, 09/2/2021, Tuesday), session-3: Expert lecture by **Dr.S.Sudhakar, Senior Scientist, CSIR – Central Electrochemical Research Institute, Karaikudi** on the topic “**Li-ion batteries : Recent Progress and Challenges**”



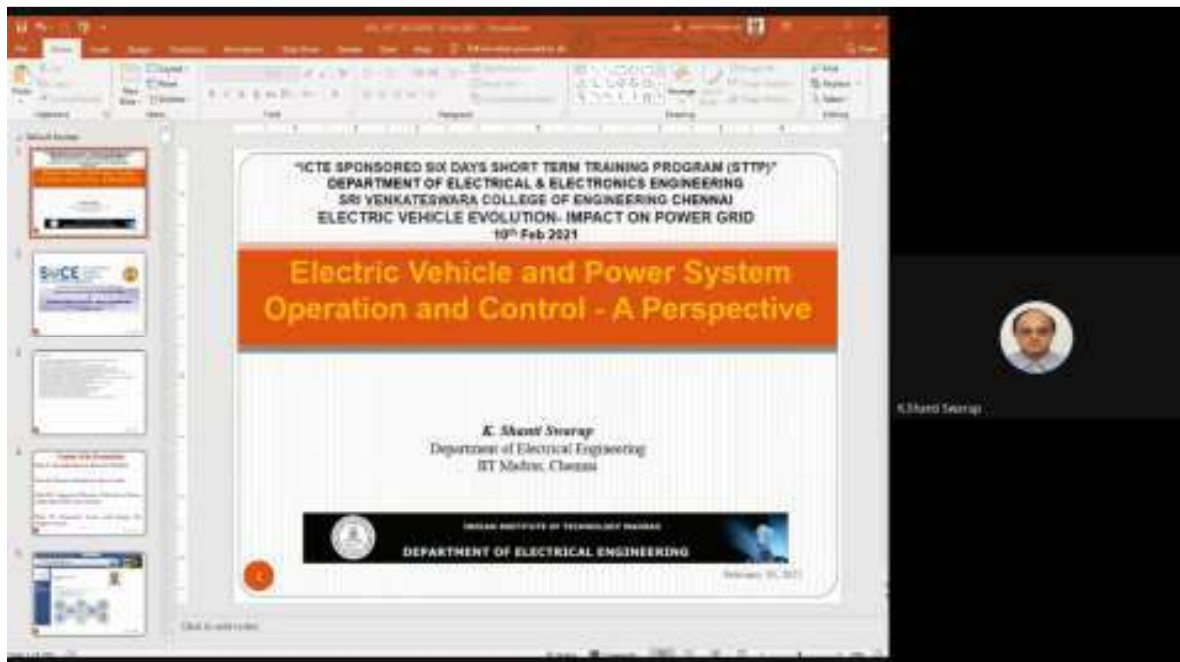
Battery Pack for Electric Cars (Tesla 1S Model)



Phase-1 (Day-2, 09/2/2021, Tuesday), session-3: Expert lecture by **Dr.S.Sudhakar, Senior Scientist, CSIR – Central Electrochemical Research Institute, Karaikudi** on the topic “**Li-ion batteries : Recent Progress and Challenges**”

Phase-1 (Day-2, 09/2/2021, Tuesday), session-3, video link:

<https://drive.google.com/file/d/145bqdnKuhmWmDzgKKYLeC90Vw6vUxq6s/view?usp=sharing>



Phase-1 (Day-3, 10/2/2021, Wednesday), session-1: Expert lecture by **Dr.K.Shanti Swarup, Professor, Indian Institute of Technology Madras** on the topic “**Electric Vehicle and Power System Operation and Control - a perspective.**”

EVS: Charging Demand Forecasting

FIGURE 1: Temporal distribution of the number of trips in different time slots

FIGURE 2: Comparison of total charging demand load among different peak methods

Transformation and Mapping of Monthly Trips of EVs to daily Trips
Forecasting of Trips of EVs to Total Charging Demand

Aim: To Determine the duration and timing of peak load.

Unanticipated Load on the Grid

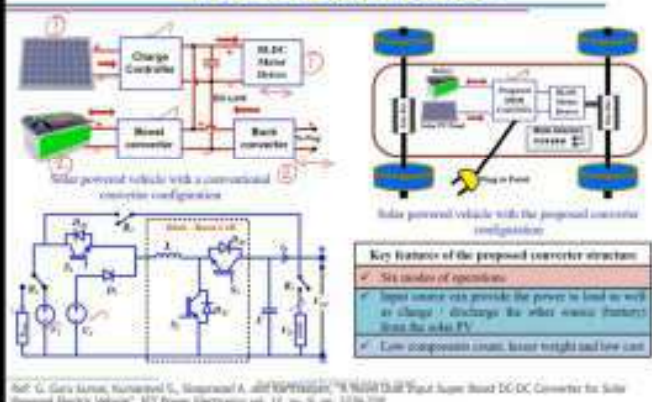
FRAMEWORK FOR V2V EV CHARGING

V2V [Vehicle to Vehicle] Charging: Impact on Grid

Phase-1 (Day-3, 10/2/2021, Wednesday), session-1: Expert lecture by **Dr.K.Shanti Swarup, Professor, Indian Institute of Technology Madras** on the topic “Electric Vehicle and Power System Operation and Control - a perspective.”

Phase-1 (Day-3), session-1, video link: <https://drive.google.com/file/d/1pHnRI-fF-e3884xjPtFDolLUuPRTnkCn/view?usp=sharing>

Dual-Input Super Boost (DISB) DC-DC Converter



Kumaravel S.

Experimental Setup and Hardware Implementation of DISB Converter

- An experimental prototype has been fabricated in the laboratory environment.
- The converter prototype is tested with two different voltage levels for the validation of experimental setup with the simulation results.
- The switching pulses are generated using TEKTRONIX APG1022 pulse generator with a switching frequency of 20 kHz.
- The parameters for the experimental validations are given in Table and the switches with diode are realized by SKM75GB12V IGBT modules.




Kumaravel S.

Phase-1 (Day-3, 10/2/2021, Wednesday), session-2: Expert lecture by **Dr.S.Kumaravel, Asso. Prof.,** **EEE Dept., National Institute of Technology, Calicut** on the topic **“Coordination of multiple Electric Vehicles, Renewable Energy Sources and Battery Energy Storage Systems in Smart Grid.”**

Phase-1 (Day-3, 10/2/2021, Wednesday), session-2, video link:

<https://drive.google.com/file/d/1GPLYYfkaZb73dcFHYsXjviagXj5th6an/view?usp=sharing>

EVs in De-regulated Power Systems

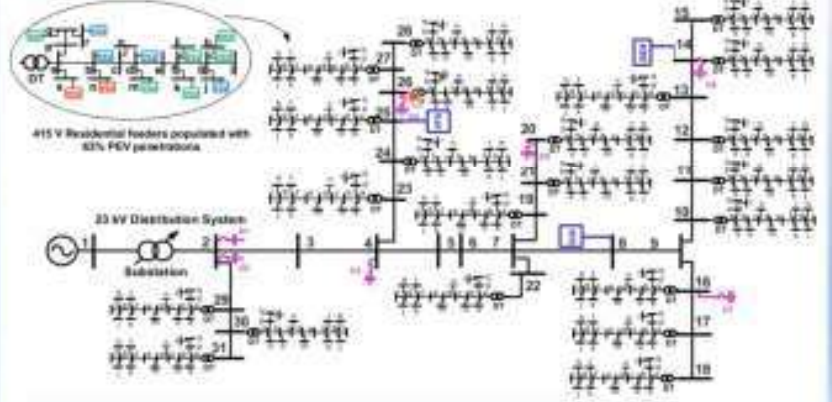





Dr. M. Venkata Kirthiga
Associate Professor
Department of EEE
National Institute of Technology Tiruchirappalli
Tamil Nadu.



Individual node in distribution system in future





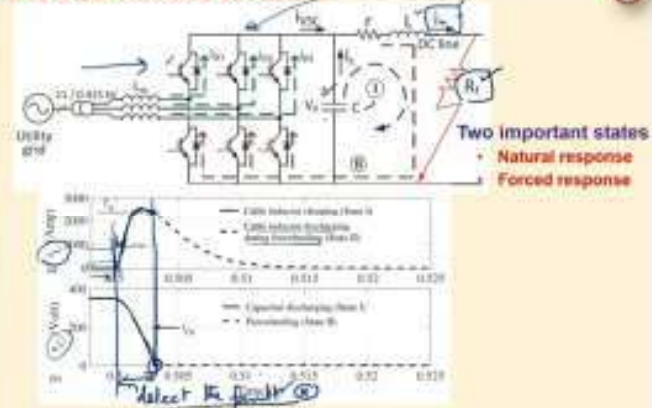
Venkata Kirthiga

Phase-1 (Day-3, 10/2/2021, Wednesday), session-3: Expert lecture by **Dr.Venkatakrithiga, Asso. Prof., EEE Dept., National Institute of Technology, Trichy** on the topic **“Impact of Electric Vehicle in Deregulated Environment”**

Phase-1 (Day-3, 10/2/2021, Wednesday), session-3, video link:

<https://drive.google.com/file/d/15J10RAo2gv619vJJwMquy5rHqABmEeBj/view?usp=sharing>

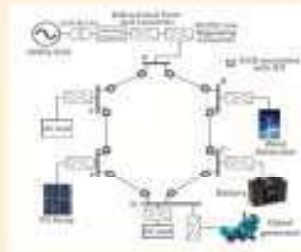
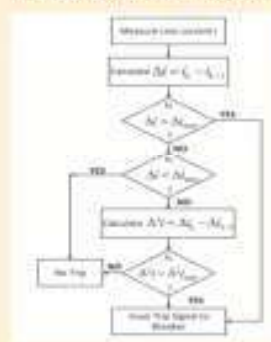
DC Short-circuit analysis



BTTP on "ELECTRIC VEHICLE EVOLUTION - IMPACT ON POWER GRID" p. Page 100, 04/11/2020

Protection Methods in DC Micro-grids*

✓ Local protection methods



BTTP on "ELECTRIC VEHICLE EVOLUTION - IMPACT ON POWER GRID" p. Page 100, 04/11/2020

Phase-1 (Day-4, 11/2/2021, Thursday), session-1: Expert lecture by **Dr.P.Raja, Asso. Prof., EEE Dept., National Institute of Technology, Tiruchirappalli** on the topic “Electric Vehicle add-on micro - Protection studies.”

Selection of Battery

- High Power/Energy density
- Toxicity, Thermal capability
- Cycle/Service life
- Small size and light weight
- Safety and Cost

Energy source	Specific energy (Wh/kg)
Fossil fuel	12000
Nuclear power	8000
Wind power	2000
Solar	4000
Lead acid battery	30
Nickel metal hydride battery	80
Lithium polymer battery	200
Lithium ion battery	150
Sodium sulfur battery	150-200
Other capacitor	4.4

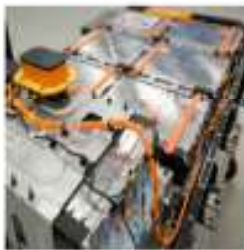
Sr. No.	Parameters	Lead Acid	NiCd	NiMH	Li-ion
1	Energy Density (Wh/Kg)	30-50	45-80	60-120	120-250
2	Power Density (W/Kg)	150-400	80-150	200-300	600-800
3	O.C. Voltage/Cell (V)	2.225	1.3	1.35	4.2
4	Temperature Range (in °C)	-20 to +60	-40 to +60	-20 to +60	-30 to +60
5	Cycle Life (Charge-discharge)	200-300	1500	300-500	500-1000

27



(I. Battery (Cont..))

EV Battery pack



Tesla Battery pack



Nissan Battery pack

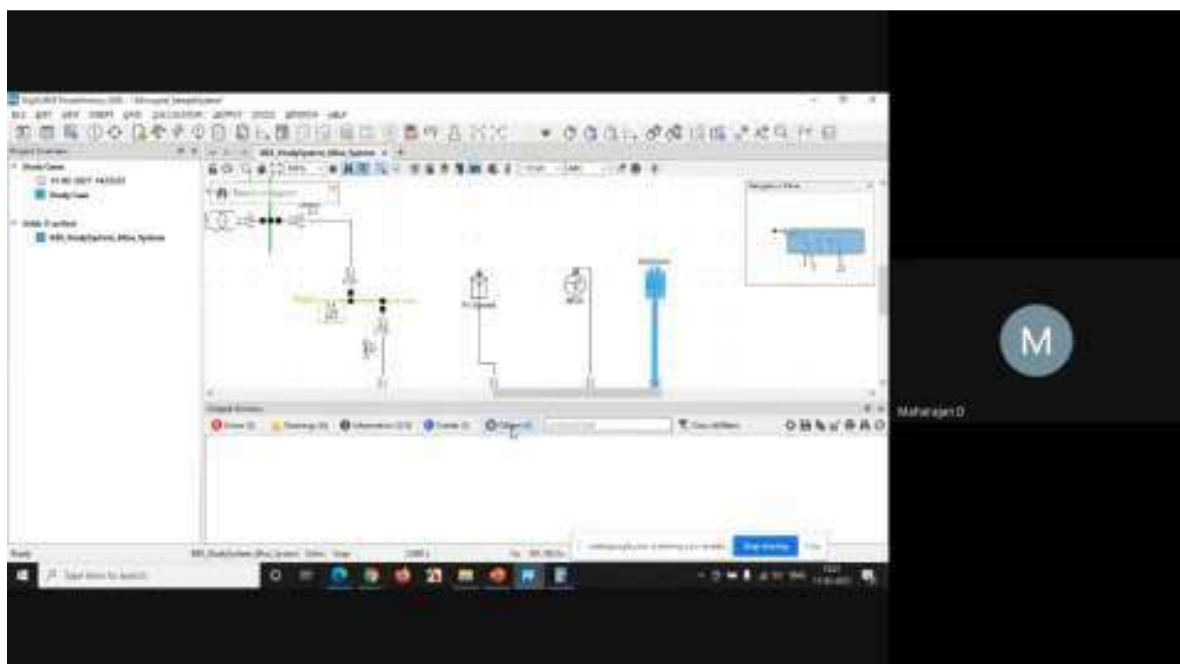
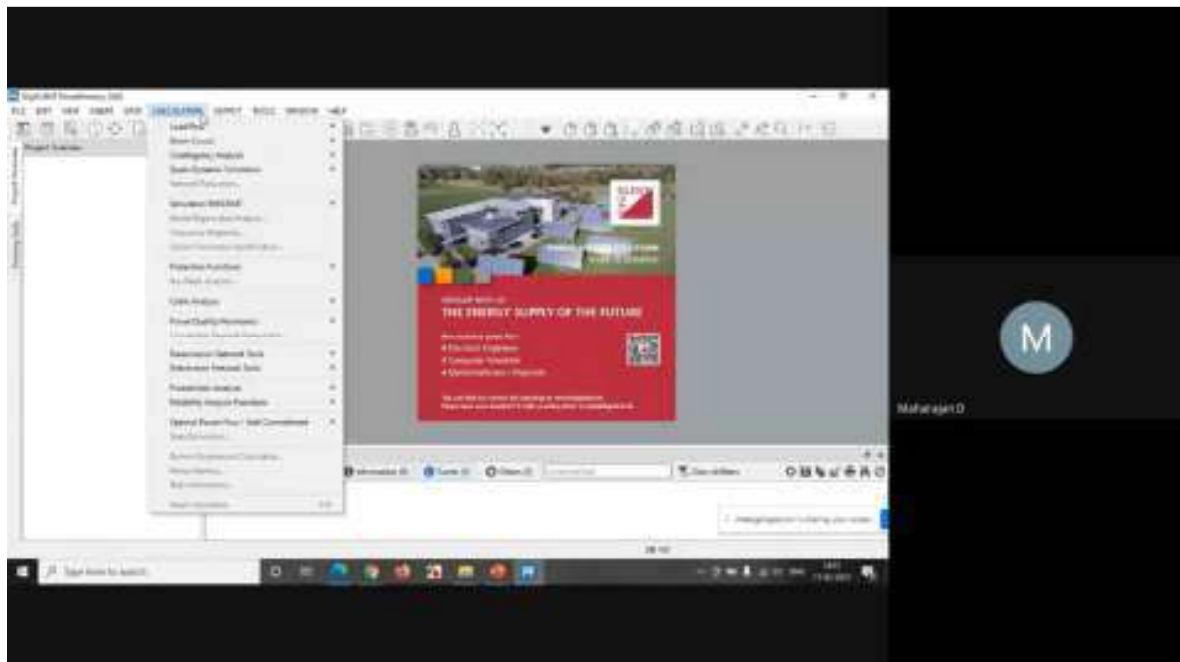
38



Phase-1 (Day-4, 11/2/2021, Thursday), session-2: Expert lecture by **Dr.V.Saravanan, Professor, EEE Dept., Arunai Engineering College** on the topic **“Battery Energy Storage Technologies for Electric Vehicle and Issues in Integration with Power Grid.”**

Phase-1 (Day-4, 11/2/2021, Thursday), session-1 & 2, video link:

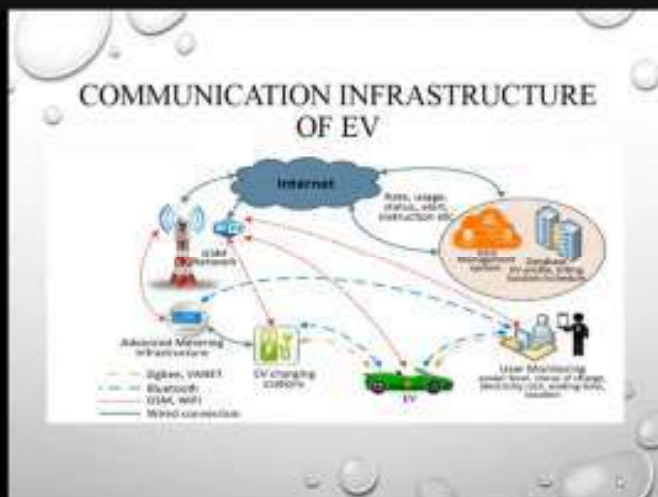
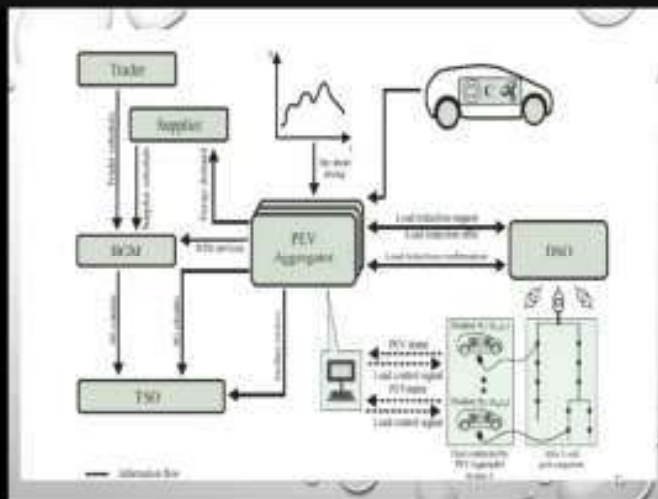
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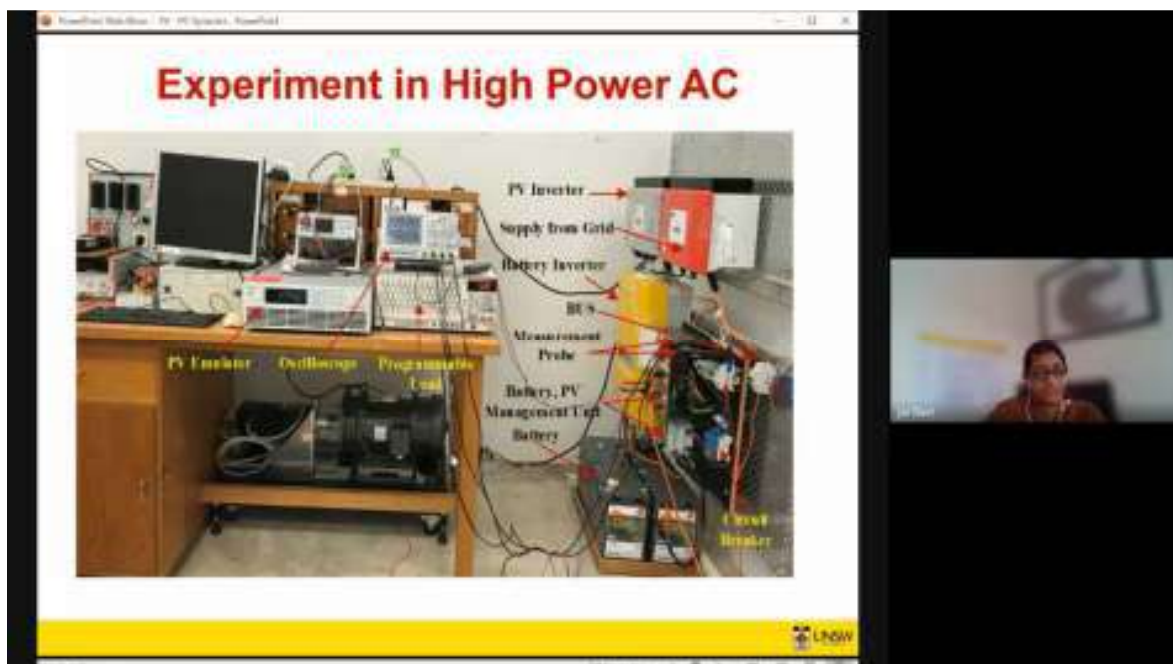
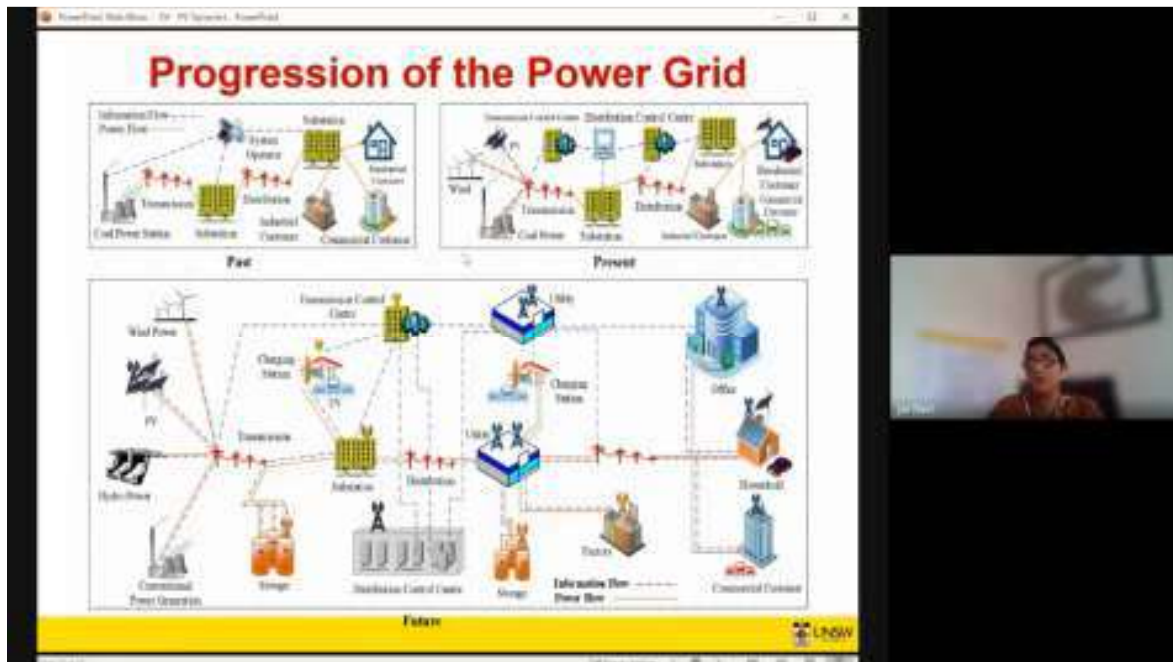
Phase-1 (Day-4, 11/2/2021, Thursday), session-3: Expert lecture and hands-on training by **Dr.D.Maharajan, Asso. Prof., EEE Dept., SRM University** on the topic **“Hands on Training on Micro/Smart grid Power System using DigSILENT”**

Phase-1 (Day-4, 11/2/2021, Thursday), session-3, video link:

<https://drive.google.com/file/d/1DogEDthQ8e3Xgpk7PpH02YBdbeDzoSeG/view?usp=sharing>



Phase-1 (Day-5, 12/2/2021, Friday), session-1: Expert lecture by **Dr.V.Gomathi**, Asso. Prof., EEE Dept, Anna University, Chennai on the topic **“Smart Grid controls - Operation and Control with Electric Vehicle.”**



Phase-1 (Day-5, 12/2/2021, Friday), session-2: Expert lecture by **Dr. R.Jayashri, Professor, School of Electrical Engineering and Telecommunications, UNSW SYDNEY, AUSTRALIA** on the topic **“Electric vehicle impact on Power System Dynamics.”**

Phase-1 (Day-5, 12/2/2021, Friday), session-1 & 2, video link:

<https://drive.google.com/file/d/13aVJmnf5FpafEgLY28iPhXTeQLn4nSfP/view?usp=sharing>

Phase-1 (Day-5, 12/2/2021, Friday), session-3 was postponed to Day-6 session 2 due to technical issues at the expert speaker end.

The rapid automobile market change has already began...

■ Shared Mobility

Change in the penetration of vehicles

Sharing economy 'Owner' to 'User'

■ Electrification

Rapid growth of EV

Expansion of "eco-friendly vehicles" with strong environmental regulations (CO₂)

■ Connectivity

Connected car market increase

Automotive ICT-based "Vehicle to Everything"

■ Autonomous

Era of fully autonomous driving has arrived ("23+30 years")

"Artificial intelligence" of automobiles in progress

Post COVID, Uncertainty in the automobile industry has increased, but it won't be able to change the 'flow to the future'

SVCE-EEE AICTE STTP: day 6 (2021-02-12 at 19:33 GMT-8)

Battery Cell Standardization

- The concept of battery cell standardization is proposed to reduce the battery cost of the electric vehicle by using the common battery cell.
 - Battery cost is about 30-40% of EV Price
- There are many issues with battery standardization.
 - Restriction on Package / Design / Vehicle performance etc.
 - When developing vehicles according to the battery, it is difficult to differentiate performance / design.
- Therefore, battery cell standardization is mandatory after 2020 for battery reduction

Hyundai Battery Package

Soul EV - On WED

Ioniq EV Under 2nd seat & luggage

Kona - On WED

Other OEM's EV Battery Package

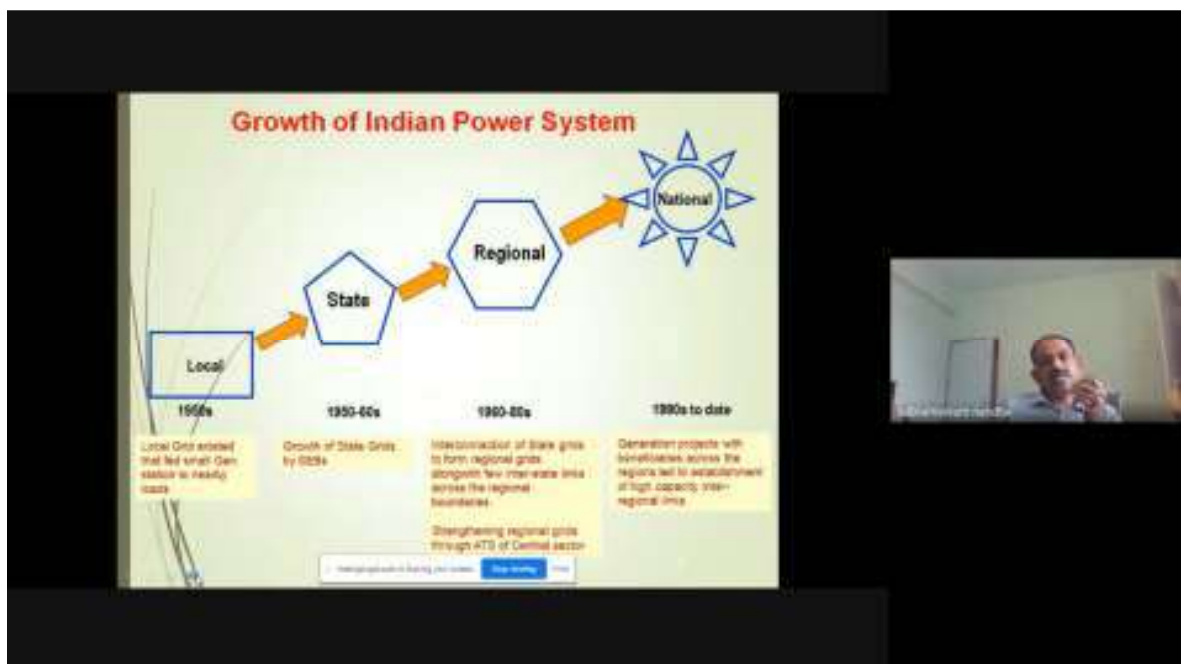
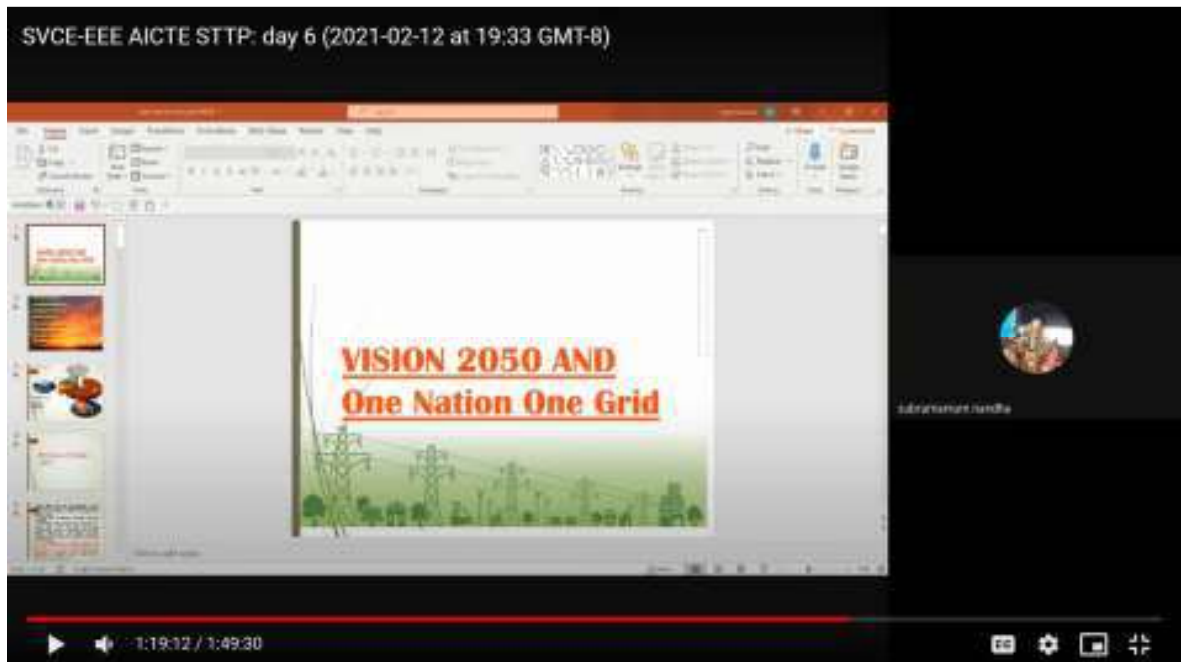
Nissan LEAF - On WED

Renault ZOE - On WED

VW e-golf - On WED

59:59 / 1:49:30

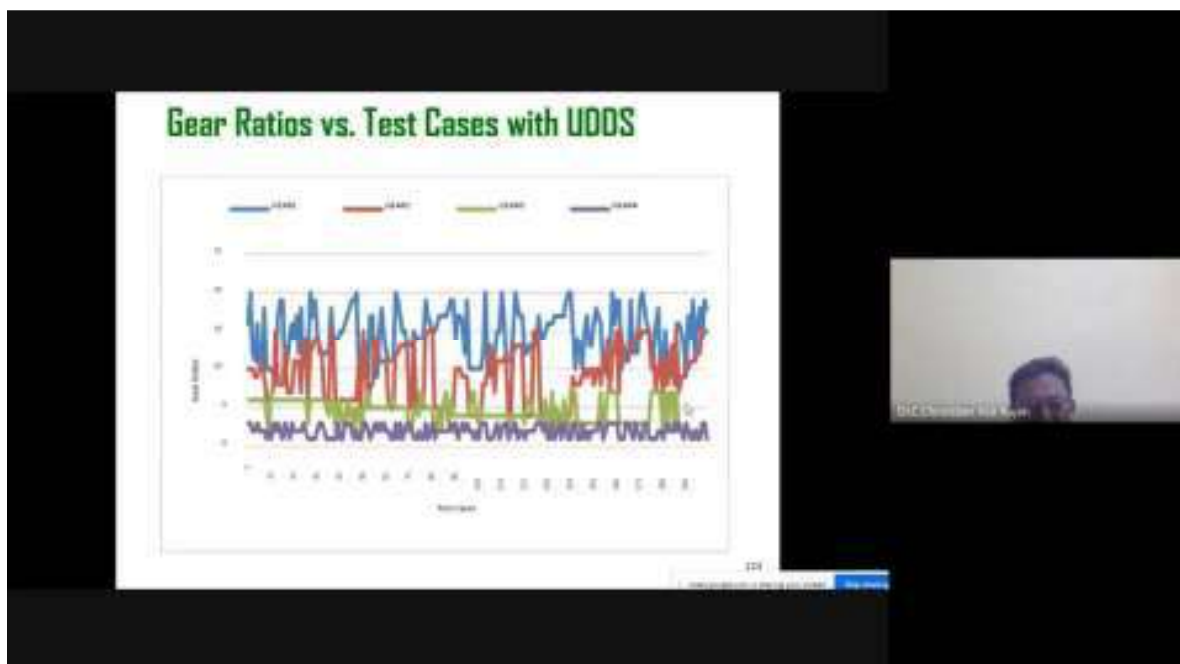
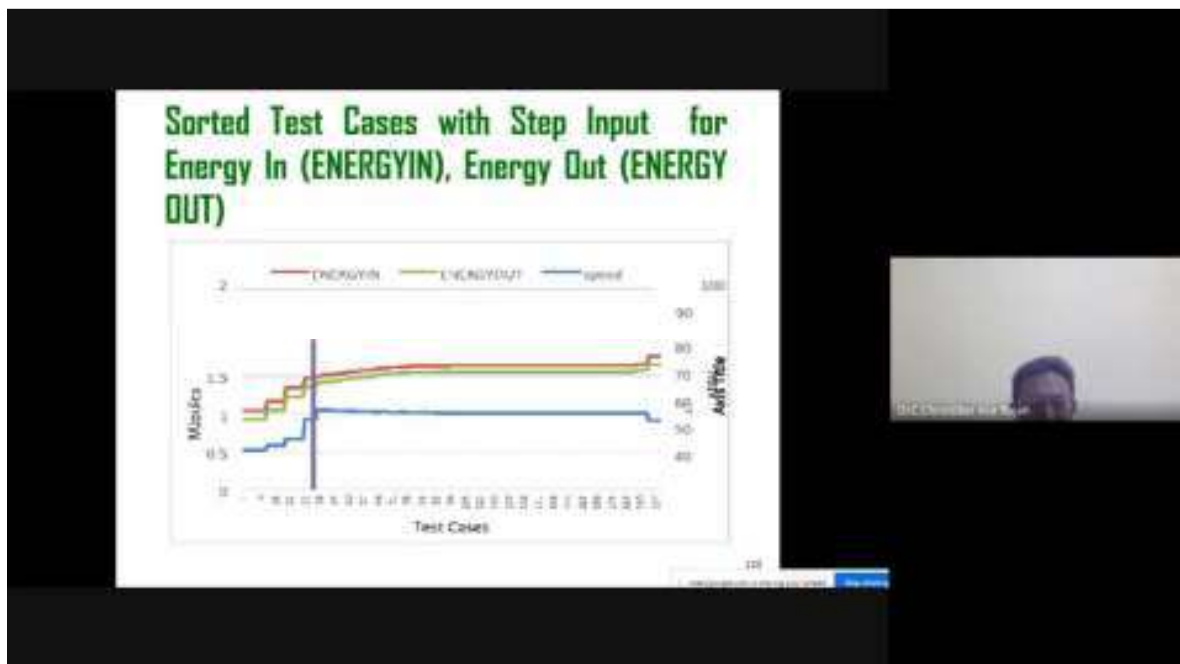
Phase-1 (Day-6, 13/2/2021, Saturday), session-1: Expert lecture by **Mr.S.Jayakrishnan, General Manager, Hyundai Motor India Ltd** on the topic **“Electric Vehicle – Future perspectives and preparedness.”**



Phase-1 (Day-6, 13/2/2021, Saturday), session-2 (postponed session 3 of Day-5): Expert lecture by **Mr.Nandhakumar, Design Engineer, Power Grid Corporation of India** on the topic “**Vision 2050: Power Grid Resiliency**”

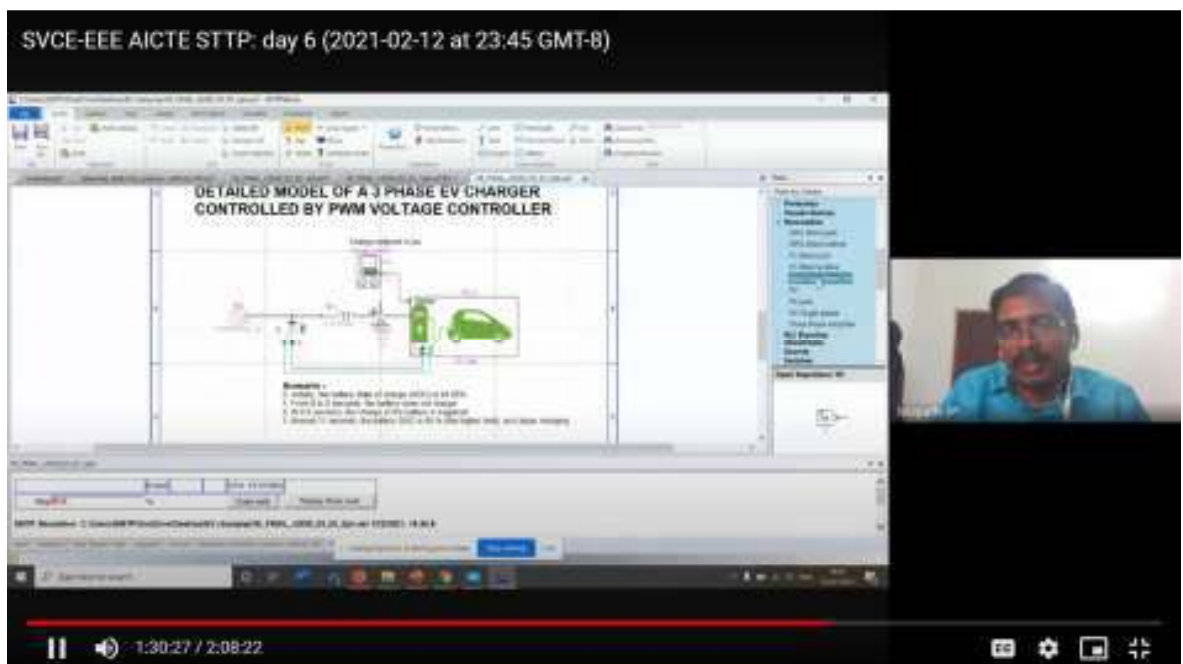
Phase-1 (Day-6, 13/2/2021, Saturday), session-1 & 2, video link:

<https://drive.google.com/file/d/1ca9mL3FsB1kB9ZYgUCNXNITq-ObT1O6U/view?usp=sharing>



Phase-1 (Day-6, 13/2/2021, Saturday), session-3: Expert lecture by **Dr.C.Christober Asir Rajan, Professor, EEE Dept , Pondicherry Engineering College** on the topic **“Optimization of Vehicle Energy flow with Residential Grid and Renewable Energy Sources.”**

Phase-1 (Day-6, 13/2/2021, Saturday), session-3, video link: <https://drive.google.com/file/d/1vTpmS-QTcRUIGkABE2LXDgRFhDHGE0Lz/view?usp=sharing>

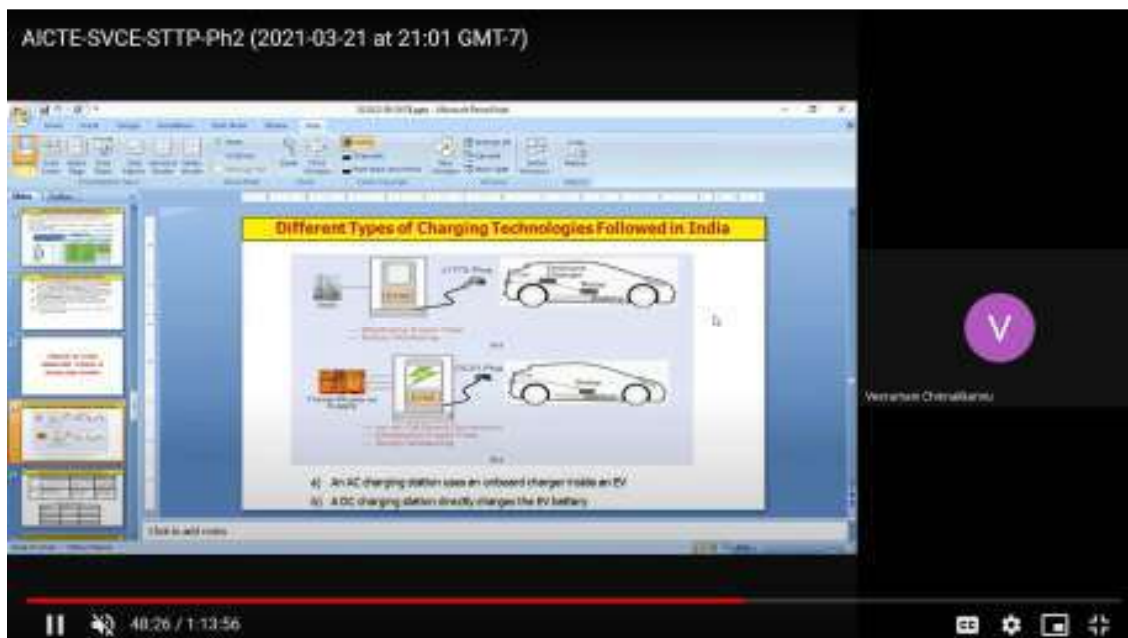
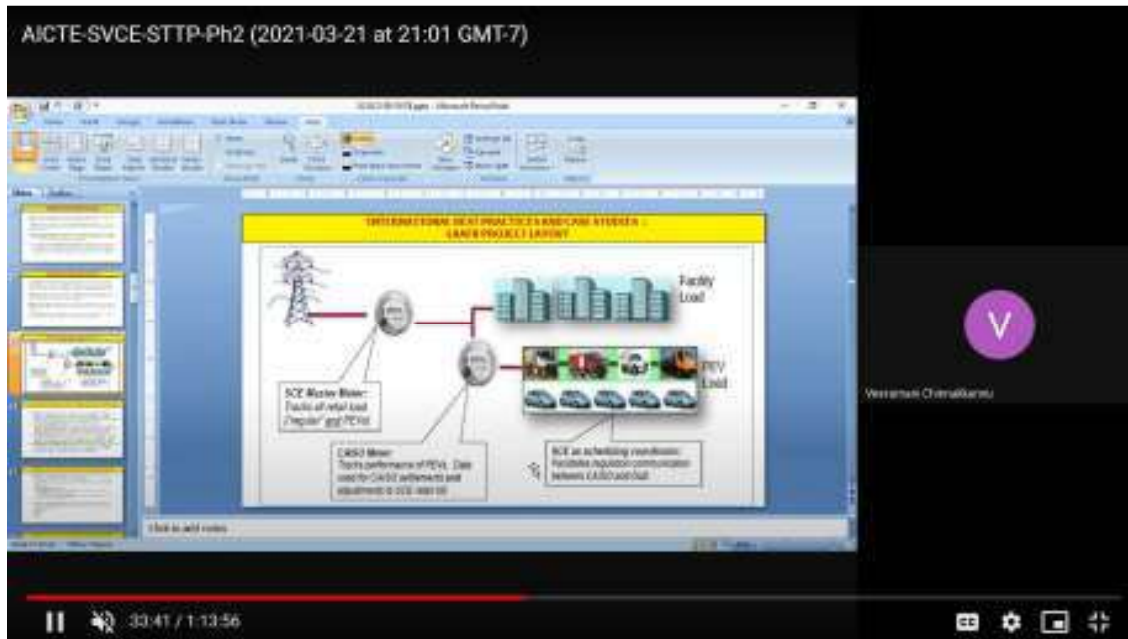


Phase-1 (Day-6, 13/2/2021, Saturday), session-4: Expert lecture and hands-on training by **Dr.V.P. Boopathi, Sr. Appn. Engineer, PWSIM Engg. Solns Pvt Ltd.** on the topic **“Hands on Training to realize the impact of Electric Vehicle on Power System Dynamics.”**

Phase-1 (Day-6, 13/2/2021, Saturday), session-4, video link:

<https://drive.google.com/file/d/1RhNQ4baCHI1Ar7b7PXfrymF420xGXISf/view?usp=sharing>

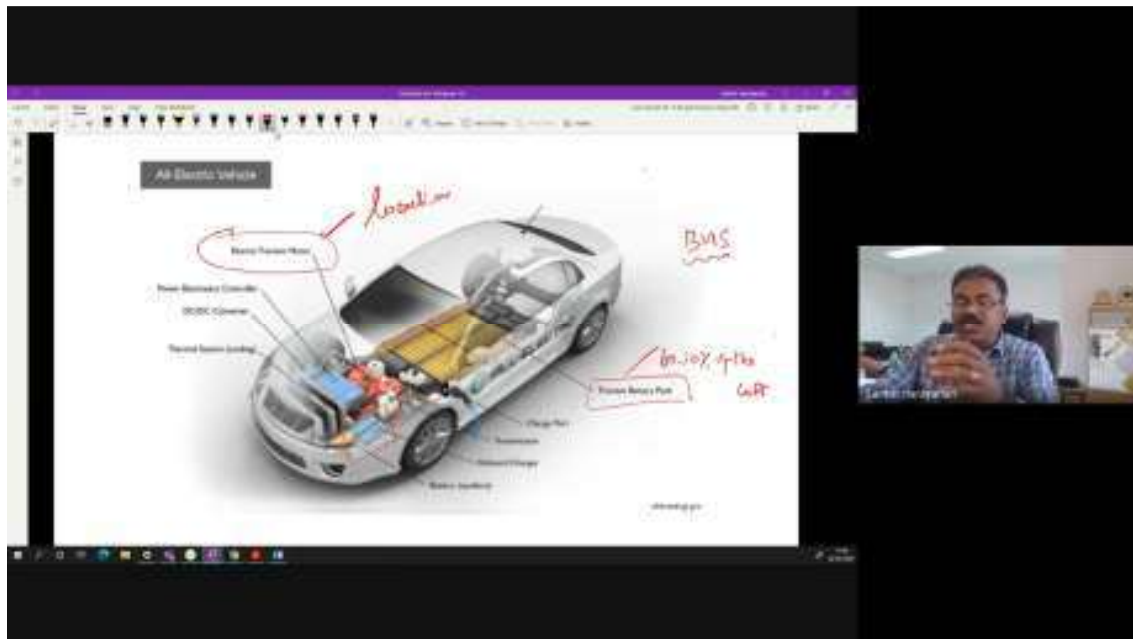
Except for few expert speaker & topic changes, the sessions of Phase-2 and 3 were the same as that of Phase-1. The details of new expert lectures for Phase-2 and 3 and their session details are given below (in addition, all the session video links of Phase-2 & 3 are given at the end):



Phase-2 (Day-1, 22/3/2021 Monday), Inauguration and session-1 expert lecture by **Dr.Veeramani, Chief Engineer (Retd), TANGEDCO** on the topic “**Impact of Renewable Energy Generation and Electric Vehicle on Power Grid – Future perspective and Preparedness.**”

Phase-2 (Day-1, 22/3/2021 Monday), session-1, video link:

<https://drive.google.com/file/d/1XIMRI67m9C-jUSyWzhemPEvbIgB2xliW/view?usp=sharing>



AICTE-SVCE-STTP-Ph2 (2021-03-21 at 22:48 GMT-7)

• The total propulsion force

$$F_t = M\alpha + MgC_{rr}\cos\theta + \frac{1}{2}\rho AC_d(V - V_w)^2 + Mgsin\theta$$

• The power to drive the vehicle at speed V

$$P = F_t V = M\alpha V + MgC_{rr}V\cos\theta + \frac{1}{2}\rho AC_d V(V - V_w)^2 + Mgsin\theta V$$

$P = F \times V$
 Force Speed

V. Sankaranarayanan | Electrical Vehicles

EV Design

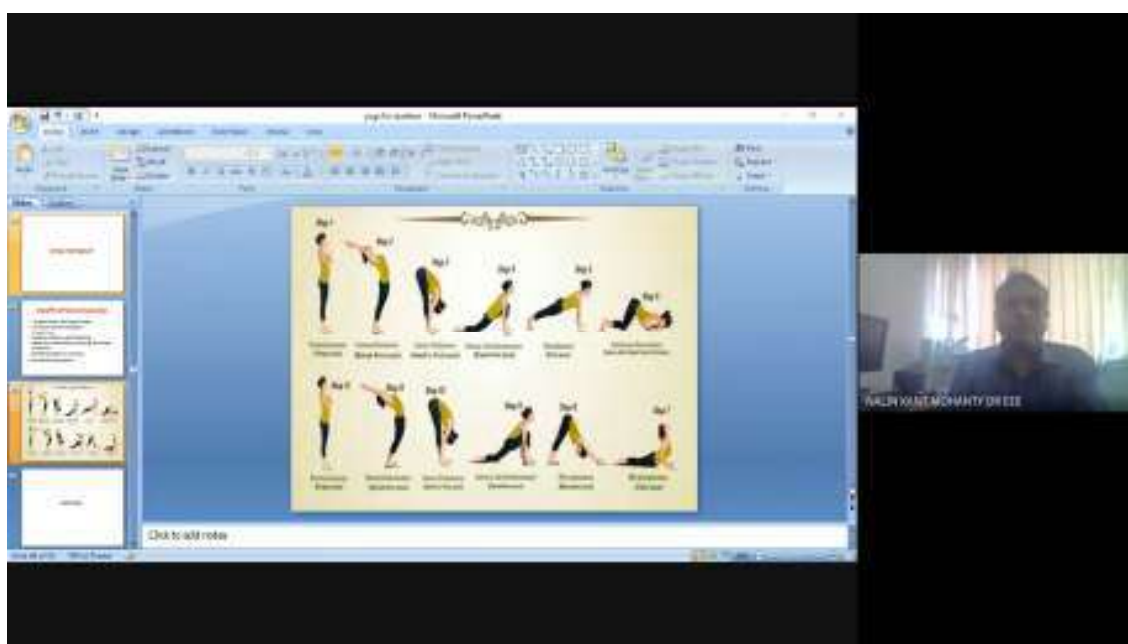
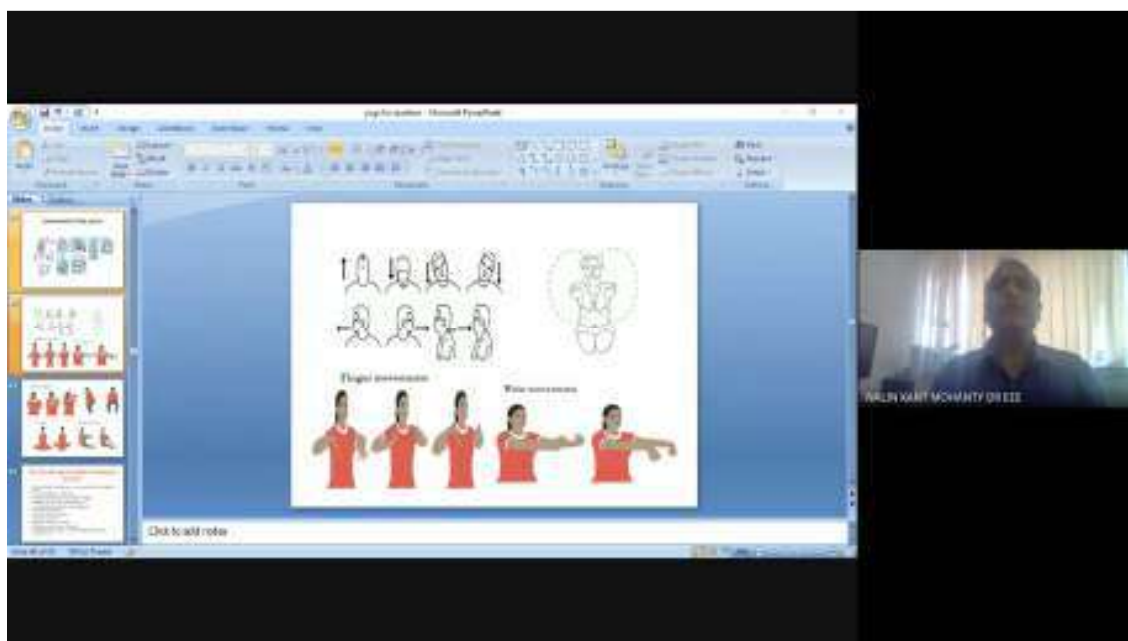
EBUS DESIGN SPECIFICATIONS

53:55 / 2:35:44

Phase-2 (Day-1, 22/3/2021 Monday), session-2: Expert lecture by **Dr. Sankara Narayanan, Professor & Head EEE Dept., National Institute of, Technology, Tiruchirappalli** on the topic **“Power Train Design.”**

Phase-2 (Day-1, 22/3/2021 Monday), session-2, video link:

<https://drive.google.com/file/d/1Q1laALLfNrdtYcXO3yhPnyk1JwBUZOA/view?usp=sharing>



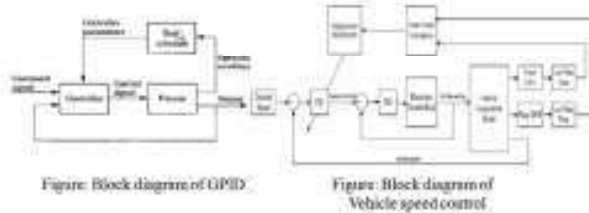
Phase-2 (Day-1, 22/3/2021 Monday), session-3: Expert lecture and online practice by **Dr.Nalin Kant Mohanty Professor, EEE Dept, SVCE** on the topic “Yoga for Teachers”

Phase-2 (Day-1, 22/3/2021 Monday), session-3, video link:

https://drive.google.com/file/d/18SW4CgzXgybhpjeot5yYRm-wrZMD_sNj/view?usp=sharing

GAIN SCHEDULED PID FOR VEHICLE SPEED CONTROL

Gain Scheduled PID controller is a nonlinear feedback controller of a special type. It is a controller that can **modify its behavior** in response to changes in the dynamics of the process and the disturbances.



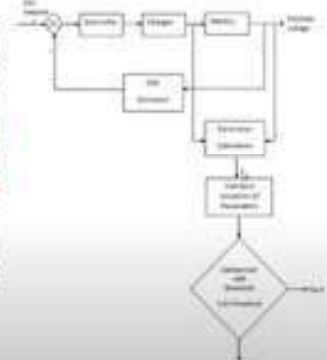
The diagram shows two interconnected systems. The left system, labeled 'Figure: Block diagram of GPID', illustrates a feedback loop where a 'Reference speed' is compared with a 'Vehicle speed' to produce an error signal. This error signal passes through a 'Controller' block, which is influenced by 'Vehicle parameters' and a 'Gain schedule' block. The output of the controller is a 'Control signal' that drives the 'Vehicle'. The right system, labeled 'Figure: Block diagram of Vehicle speed control', shows the vehicle's internal dynamics, including a 'Vehicle model' block that receives the control signal and outputs the 'Vehicle speed', which is fed back to the GPID controller.

Figure: Block diagram of GPID Figure: Block diagram of Vehicle speed control

AICTE-SVCE-STTP Ph2 (Day2) (2021-03-22 at 21:17 GMT-7)

FAULT DIAGNOSIS IN FAST CHARGING BATTERY

- Bias fault occurs in Fast charging battery system can be diagnosed by estimating the battery parameters such as charging time constant and internal resistance of the battery using Adaptive Unscented Kalman Filter (AUKF).
- The standard deviations of the estimated battery parameters are compared with threshold values.

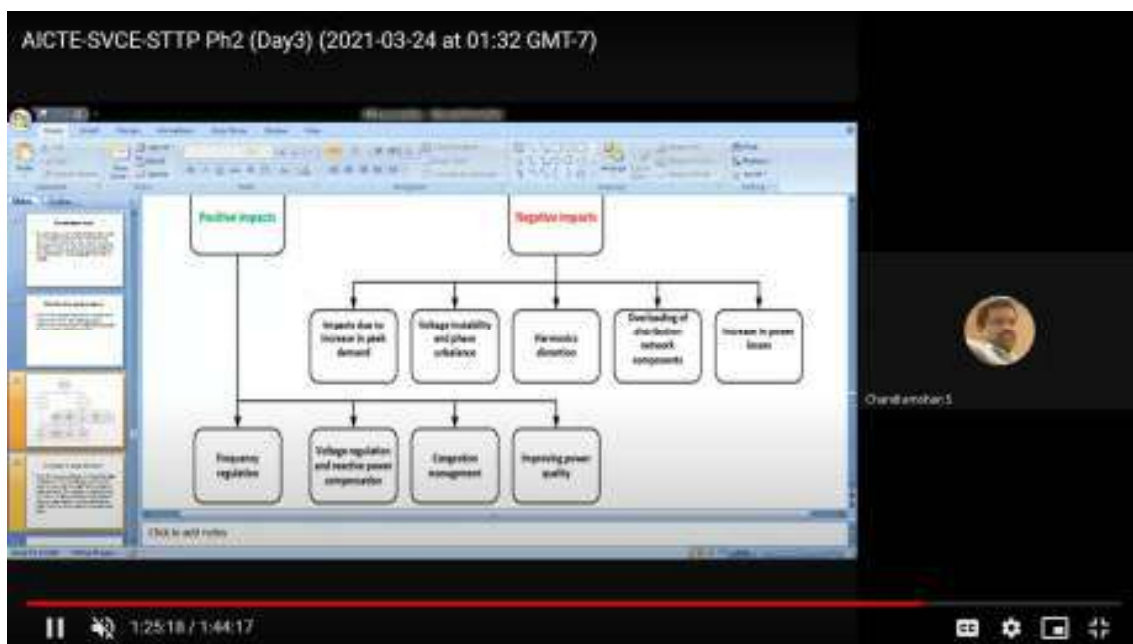
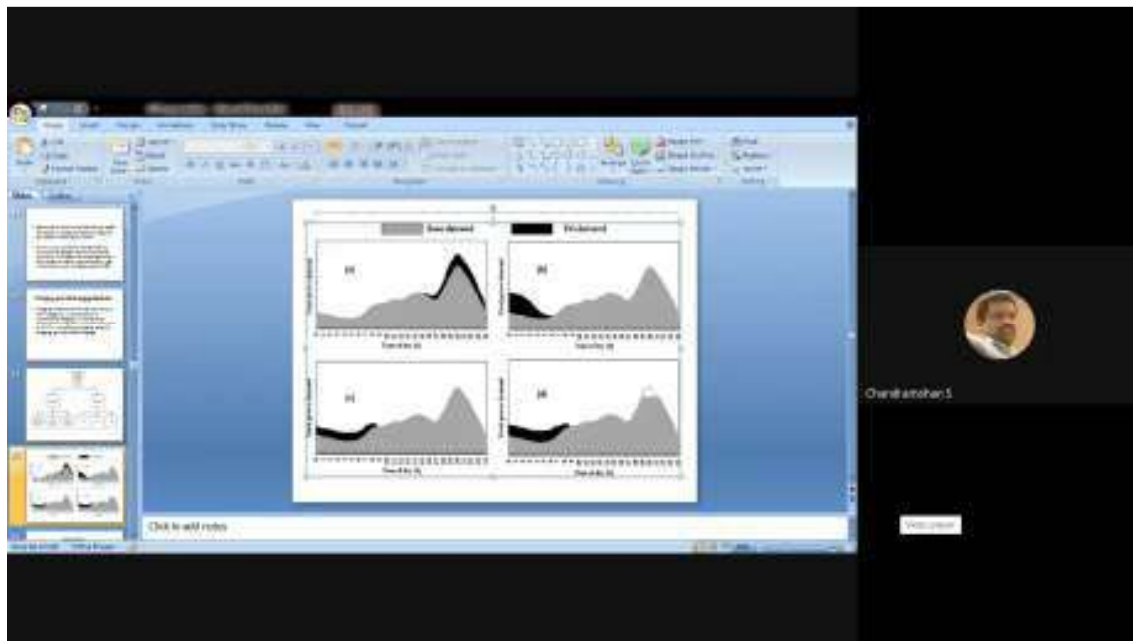


The diagram illustrates a fault diagnosis system for a fast-charging battery. It starts with a 'Battery model' block that receives a 'Charging current' and outputs a 'Battery voltage'. This voltage is compared with a 'Reference voltage' to produce an error signal. The error signal is processed by an 'AUKF' (Adaptive Unscented Kalman Filter) block, which estimates the 'Battery parameters'. These parameters are then compared with 'Threshold values' in a decision diamond. If a fault is detected, the system outputs a 'Fault' signal; otherwise, it outputs a 'Normal' signal.

Phase-2 (Day-2, 23/3/2021 Tuesday), session-1 (on the request of the Expert speaker, the session 2 was preponed to session 1): Expert lecture by **Dr S. Kalpana, Asst. Professor, Madras Institute of Technology, Chennai** on the topic **“Design and implementation of controllers and control strategies for Electric Vehicle.”**

Phase-2 (Day-2, 23/3/2021 Tuesday), session-1, video link:

<https://drive.google.com/file/d/1m4h2Nx570c1NgKlqNg7JTcKEDS6be9Nc/view?usp=sharing>



Phase-2 (Day-3, 24/3/2021 Wednesday), session-3: Expert lecture by **Dr. S.Chandramohan, Prof. & HOD/EEE Dept., College of Engineering, Guindy, Anna University, Chennai** on the topic **“Impact of Electric Vehicle in Deregulated Environment.”**

Phase-2 (Day-3), session-3, video link: <https://drive.google.com/file/d/1GBRceQy-QyVqFfSqdchx23gvA1mW5y/view?usp=sharing>

Problem Formulation

• **Objective Function**

$$\min f(\text{cost}) = \sum_{t=1}^T \left\{ \left[\begin{aligned} &[(P_{grid}(t) \times dt) \times C_{grid}(t)] + \\ &[(P_{PV}(t) \times dt) \times C_{PV}(t)] + \\ &[(P_W(t) \times dt) \times C_W(t)] + \\ &\left[\left(\sum_{i=1}^{N_{EV}} P_{EV}^{Disch}(t, i) \times dt \right) \times C_{EV}^{Disch}(t) \right] + \\ &[(P_b^{Disch}(t) \times dt) \times C_b^{Disch}(t)] - \\ &[(P_{Inject}(t) \times dt) \times C_{sell}(t)] \end{aligned} \right] \right\}$$

Somasundaram Periasamy

AICTE-SVCE-STTP Ph2 (Day4) (2021-03-24 at 21:06 GMT-7)

• **Energy resource management for four days**

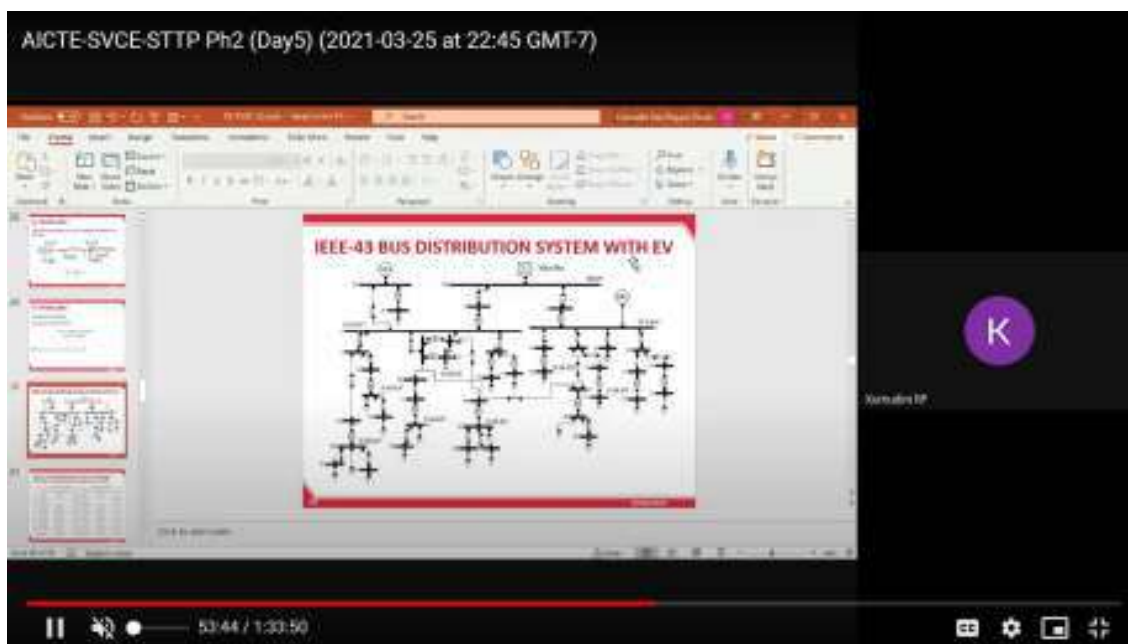
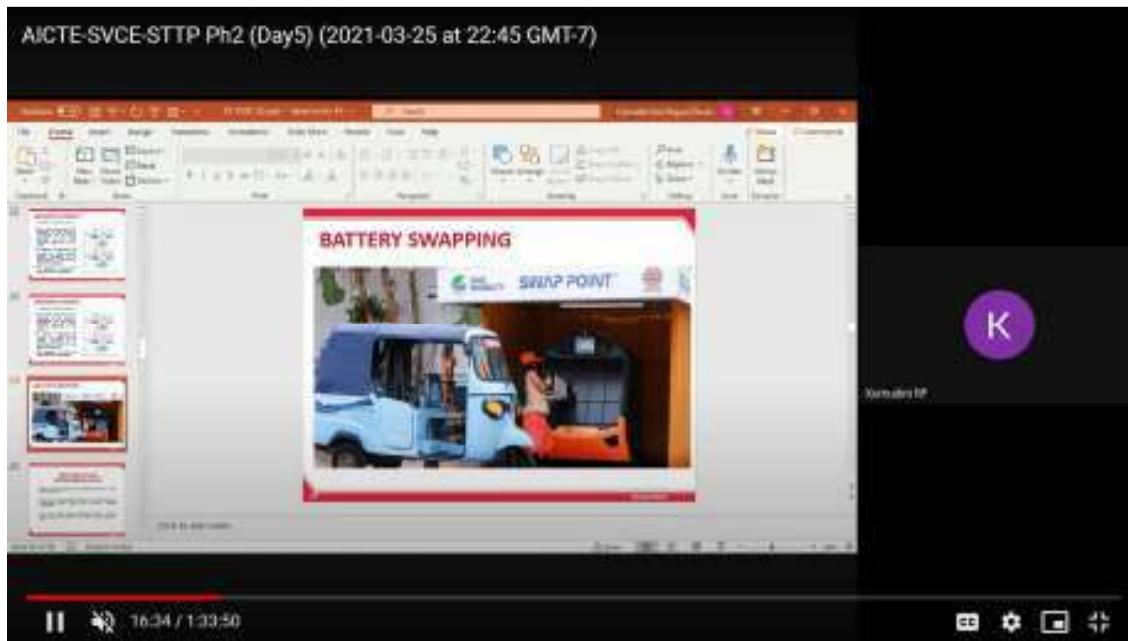
Somasundaram Periasamy

11 1:12:05 / 1:33:57

Phase-2 (Day-4, 25/3/2021 Thursday), session-1 (on the request of the Expert speaker, the session 2 of Day-6 was preponed to session 1 of Day-4): Expert lecture by **Dr.P.Somasundaram, Prof./EEE Dept., College of Engineering, Guindy, Anna University, Chennai** on the topic “**Optimization of Vehicle Energy flow with Residential Grid and Renewable Energy Sources.**”

Phase-2 (Day-4, 25/3/2021 Thursday), session-1, video link:

<https://drive.google.com/file/d/1OiafAaot9f9b7ApVJGXwn6-ArJgOVIV/view?usp=sharing>



Phase-2 (Day-5, 26/3/2021 Friday), session-2 (on the request of the Expert speaker, the session 1 of Day-4 was postponed to session 2 of Day-5): Expert lecture by **Dr. R.P.Kumudini Devi, Professor, College of Engineering, Guindy, Anna University, Chennai** on the topic “**Electric Vehicle and Power System Operation and Control – a perspective.**”

Phase-2 (Day-5, 26/3/2021 Friday), session-2, video link:

<https://drive.google.com/file/d/1MXYzNDInMS8WYLH8ZpyDpETVOG1PnB7w/view?usp=sharing>

AICTE-SVCE-STTP Ph2(Day 6) (2021-03-26 at 21:04 GMT-7)

Two-level Inverter - DC to 3-Ph AC

- DC link Voltage = 2800V
- 3 Ph, AC output Voltage = 2100V
- 3 Ph, AC output current = 270A

40:18 / 1:26:48

AICTE-SVCE-STTP Ph2(Day 6) (2021-03-26 at 21:04 GMT-7)

Locomotive - Quad Voltage Configuration

1:05:23 / 1:26:48

Phase-2 (Day-6, 27/3/2021 Saturday), session-1: Expert lecture by **Mr.B.Saravanan, Lead-Traction control, Alstom, Bangalore** on the topic “Electric Traction”


Phase-2 (Day-6, 27/3/2021 Saturday), session-1, video link:

<https://drive.google.com/file/d/1aTNaG4V9S-RuYr5bFVuvtc16GT7c0Ne4/view?usp=sharing>

Use Case 1– School Bus to Grid

Dominion Energy

- Vehicle-to-grid Technology (V2G) accelerates the clean energy revolution.
- Dominion, a utility in Virginia, US is one of the first to integrate V2G into its commercial operations, with the first 50 electric buses expected to be operational by the end of 2020.
- The integration of a new 2.6-gigawatt offshore wind farm, Dominion Energy has devised a plan to use batteries within electric school buses as a grid flexibility asset.
- Dominion will provide selected local schools with 50 battery-powered buses equipped for bidirectional charging. When the vehicles are idle, the utility will store excess energy in the batteries and draw it back in peak hours.




37:01 / 54:57

Electric Aircraft

Rolls-Royce e47BL project

Another vehicle added a name, Rolls-Royce's eVTOL, motor was first unveiled at the 2016 Partnership International Airshow.



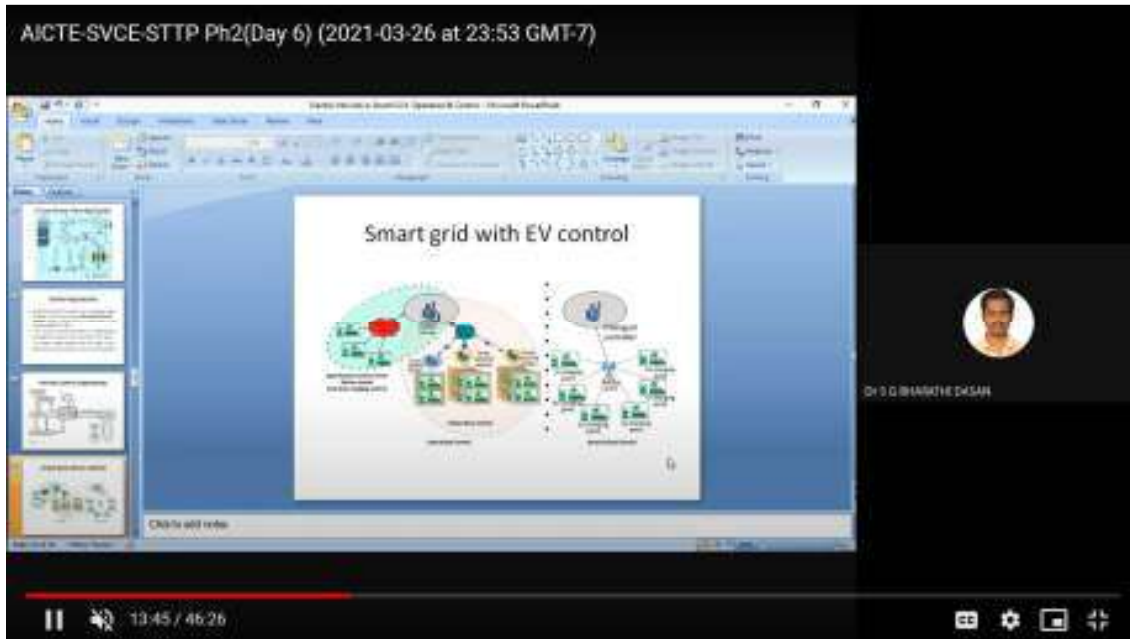
- The vehicle will be hybrid-powered with a modified Rolls-Royce M250 gas turbine at the rear of the craft powering six electric propellers specially designed to have a low noise profile. In this configuration it could carry four or five passengers at speeds up to 250mph for approximately 500 miles and would not require re-charging as the battery is charged by the gas turbine.

Phase-2 (Day-6, 27/3/2021 Saturday), session-2 (on the request of the Expert speaker, the session 2 of Day-5 was postponed to session 2 of Day-6): Expert lecture by **Dr.N.Sivakumar, Global Technical lead, Rolls-Royce, Singapore** on the topic **“Configuration and components of Electric Vehicle – Overview.”**

Phase-2 (Day-6, 27/3/2021 Saturday), session-2, video link:

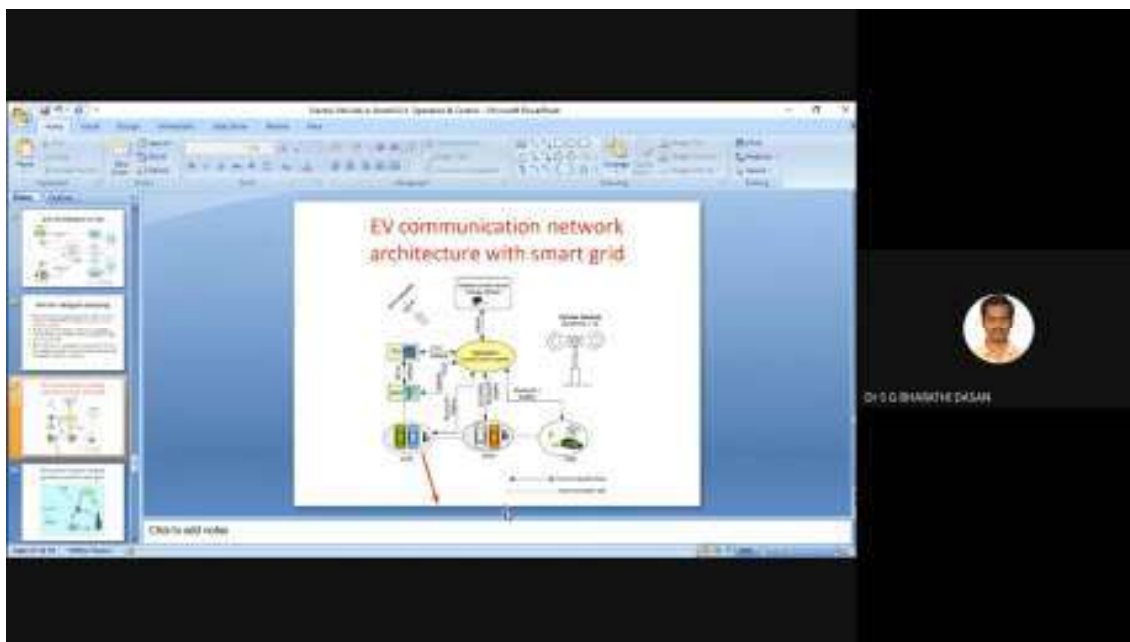
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AICTE-SVCE-STTP Ph2(Day 6) (2021-03-26 at 23:53 GMT-7)



Smart grid with EV control

Dr S G BHARATHIDASAN



EV communication network architecture with smart grid

Dr S G BHARATHIDASAN

Phase-2 (Day-6, 27/3/2021 Saturday), session-3: Expert lecture by **Dr.S.G.Bharathidasan, Asso. Prof., EEE Dept., SVCE** on the topic “**Smart Grid with Electric Vehicle.**”

Phase-2 (Day-6, 27/3/2021 Saturday), session-3, video link:

https://drive.google.com/file/d/1n59MDxPTLvQV_zoWxokx3FVBd8XJVbmA/view?usp=sharing

AICTE-SVCE-STTP Ph3(Day 1) (2021-04-18 at 21:25 GMT-7)

Why the variability is a problem for grid operators?

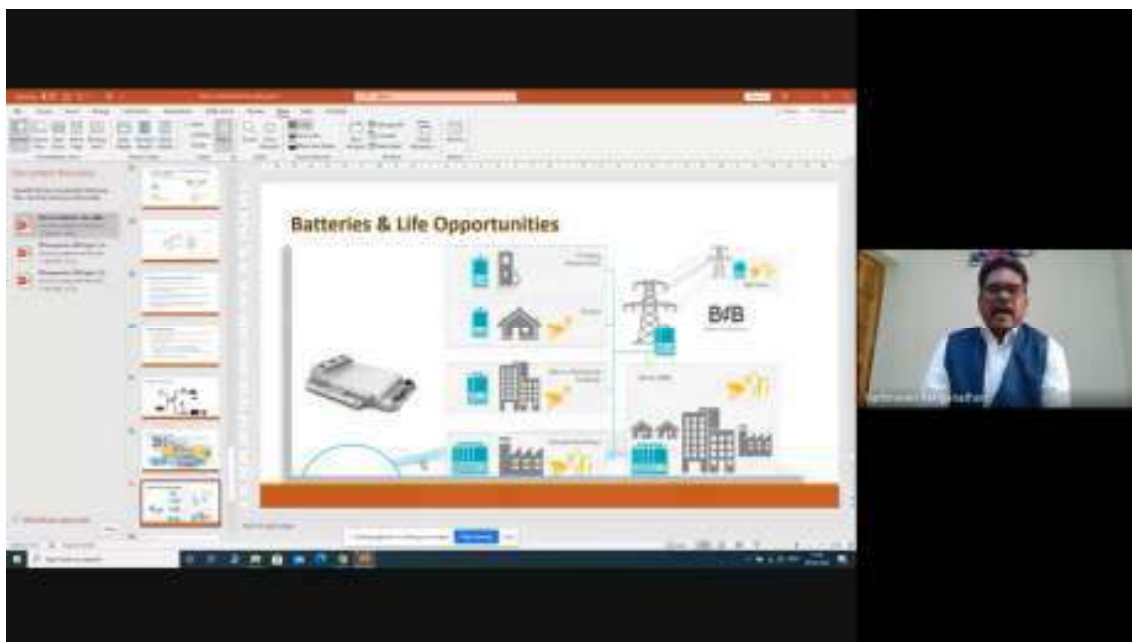
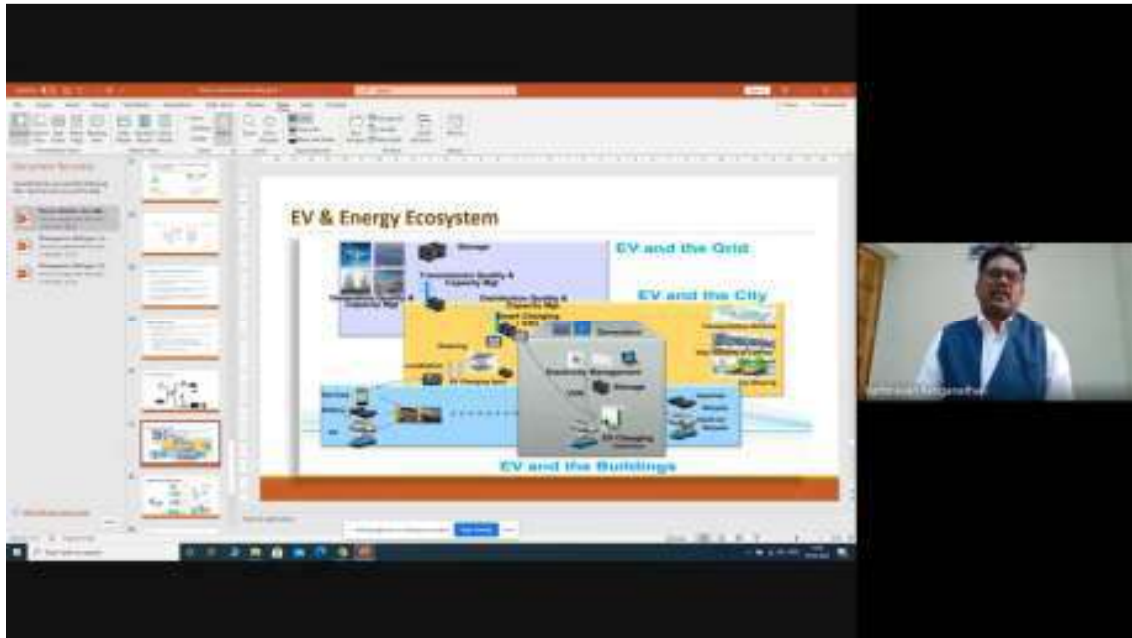
- 1. Power systems are generally designed to manage, tolerate the variability.
- 2. Renewable-variability needs additional balancing assets.
- 3. Increased flexibility requirements to accommodate higher variability.
- 4. Significant response for accommodation required up to short-term to long-term generation.
- 5. High forecasting accuracy requirements during short-term periods due to high unpredictability.
- 6. Power BE required for high wind penetration than high wind generation.
- 7. Conventional generation used to meet the rest but due to much less fuel cost.
- 8. High capacity requirements and need to operate at reduced efficiency in reserve state due to.

49:41 / 3:21:10

EV to Grid

49:41 / 3:21:10

Phase-3 (Day-1, 19/4/2021 Monday), session-1: Inauguration and session-1 expert lecture by **Dr.R.Kathiravan, Executive Engineer, TANGEDCO** on the topic **“Impact of Renewable Energy Generation and Electric Vehicle on Power Grid – Future perspective and Preparedness.”**



Phase-3 (Day-1, 19/4/2021 Monday), session-1: Inauguration and session-1 expert lecture by **Dr.R.Kathiravan, Executive Engineer, TANGEDCO** on the topic **“Impact of Renewable Energy Generation and Electric Vehicle on Power Grid – Future perspective and Preparedness.”**

Phase-3 (Day-1, 19/4/2021 Monday), session-1, video link:

<https://drive.google.com/file/d/1nDCz0ujXJOan5VU7O6djS0Dk3sUvf48u/view?usp=sharing>

AICTE-SVCE-STTP Ph3(Day 4) (2021-04-22 at 01:29 GMT-7)

Main Benefits of V2X- Future Possibilities

Leading Conversion Technology for Power Resilience

1:13:23 / 1:48:18

Hercules architecture

• Double conversion with internal energy buffering.

Leading Conversion Technology for Power Resilience

Phase-3 (Day-4, 22/4/2021 Thursday), session-3: Expert lecture by **Mr.Rathnakumar Devaraj**, Industrial &Systems, Development Engineer, CE+T Power, Wandre, Belgium on the topic “Modular Multidimensional Converters & Application.”

AICTE-SVCE-STTP Ph3(Day 4) (2021-04-22 at 01:29 GMT+7)

Recommendation-Smart Charging

SUPPLY

Smart charging stations also allow to schedule the charging of electric vehicles according to the availability of renewable energy sources.

DEMAND

Thanks to smart charging, your electric vehicle can be charged when the renewable energy sources are available.

Smart charging stations also allow to schedule the charging of electric vehicles according to the availability of renewable energy sources.

Leading Conversion Technology for Power Resilience

Bidirectional - Smart Charging

The new European ISO 15118-20 standard will be released in 2021. New standard will accelerate the V2G market because it enables bidirectional power transfer for multiple cars.

In practice this means that EV battery capacity for energy management will grow heavily in the next couple of years.

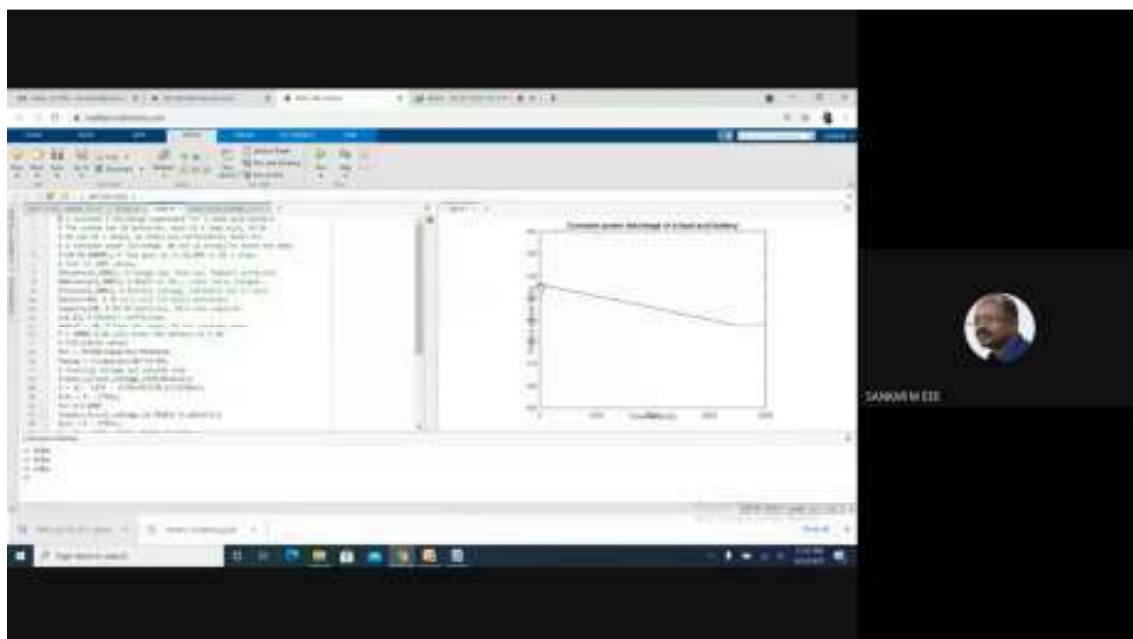
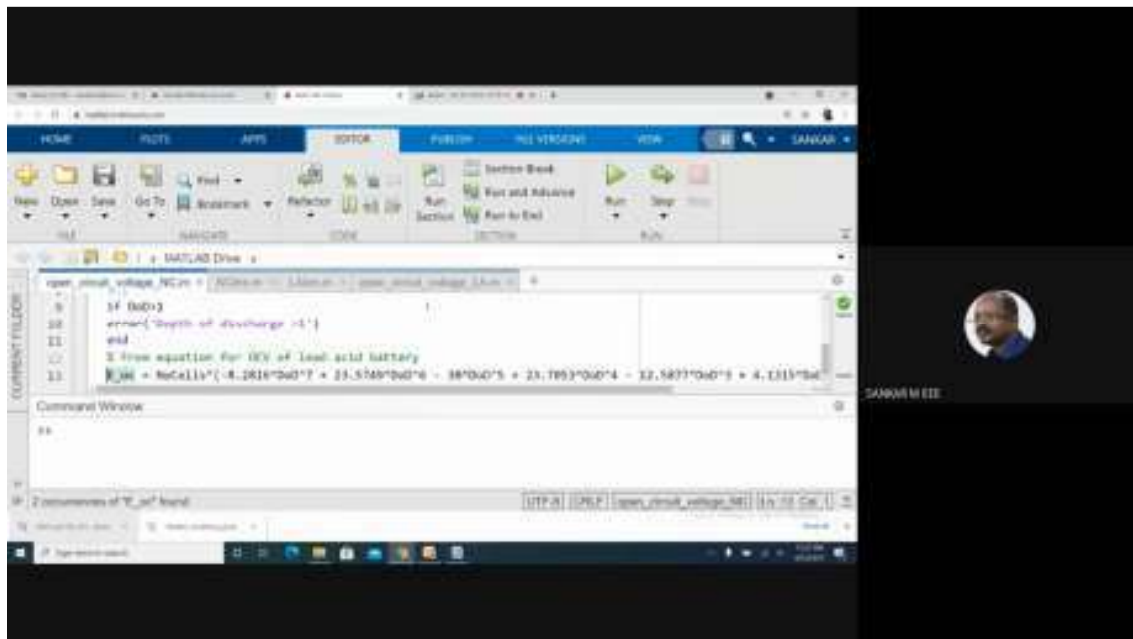
For example, European car manufacturers will implement the bidirectional charging. This will be peak battery capacity for the European electricity system.

Leading Conversion Technology for Power Resilience

Phase-3 (Day-4, 22/4/2021 Thursday), session-3: Expert lecture by **Mr.Rathnakumar Devaraj, Industrial &Systems, Development Engineer, CE+T Power, Wandre, Belgium** on the topic **“Modular Multidimensional Converters & Application.”**

Phase-3 (Day-1, 22/4/2021 Thursday), session-3, video link:

<https://drive.google.com/file/d/10hqjpmF1B4cNCsDn0fGU0-JiT7zpdTg/view?usp=sharing>



Phase-3 (Day-6, 24/4/2021 Saturday), session-2: Expert lecture by **Dr.M.Sankar, Asst. Prof./EEE, SVCE** on the topic **“Battery Modeling”**

Phase-3 (Day-6, 24/4/2021 Saturday), session-2, video link:

<https://drive.google.com/open?id=1hey1UloyY45A0MBI3zVkjyi3z10bsWfm>

Phase-2 (22nd March to 27th March 2021) all the sessions' video link:

https://drive.google.com/drive/u/0/folders/1feoZpKXklrCUNeVO0_9E9RUYXfW7GxLa

Phase-3 (19th April to 24th April 2021) all the sessions' video link:

<https://drive.google.com/drive/u/0/folders/1-DX-4gv6U6ip0ANLXkl770NWaBuO1Lv7>



S G BHARATHIDASAN, Associate
Professor, Coordinator



Head of the Department
Department of Electrical and Electronics Engineering
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PHASE-1

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35	V.KUBENDRAN	Assistant professor	EEE	SRM Institute of Science and Technology
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72	BINAYA KUMAR MALIKA	Assistant Professor	EE	Einstein Academy of Technology and Managment, Bhubaneswar
73	Madhu Valavala	Associate Professor	EEE	Swarnandhra College of Engineering and Technology
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81	Jani dilip batukray	Associate professor	Mechanical	Government engineering college Dahod
82	Dr. P. ITHAYA RANI	Associate Professor	Computr Science and Technology	KL University
83	MANONEET KUMAR	Assistant Professor	Mechanical Engineering	Shri Vishnu Engineering College for Women(Autonomous)
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PHASE-2

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3	SRIANANDA GANESH T	Assistant professor	EEE	ST. JOSEPH'S COLLEGE OF ENGINEERING
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PHASE-3

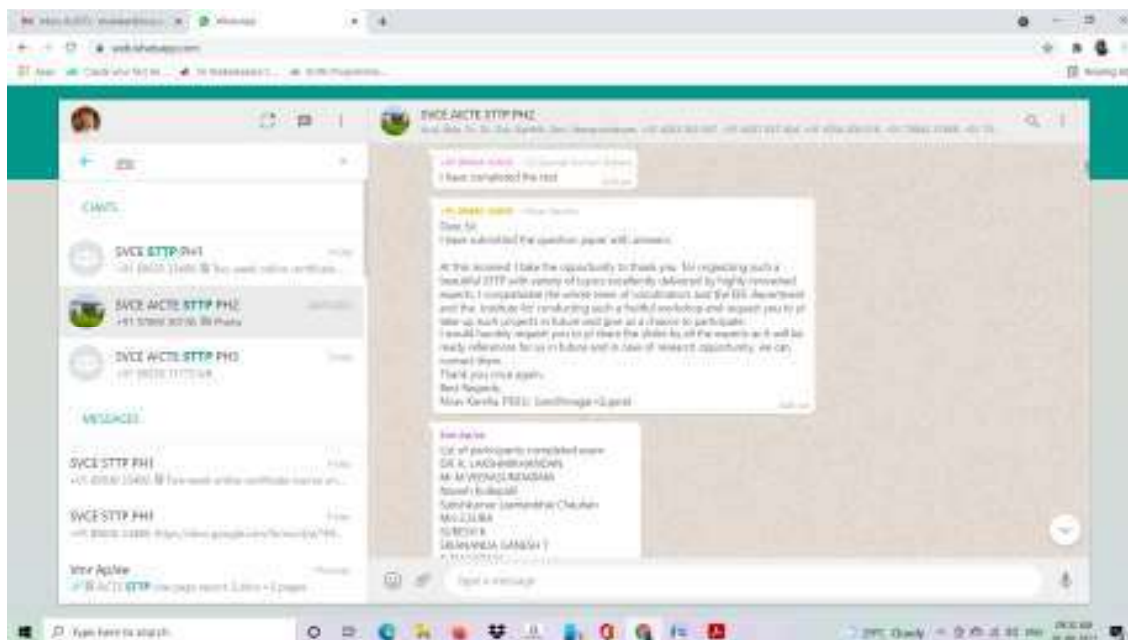
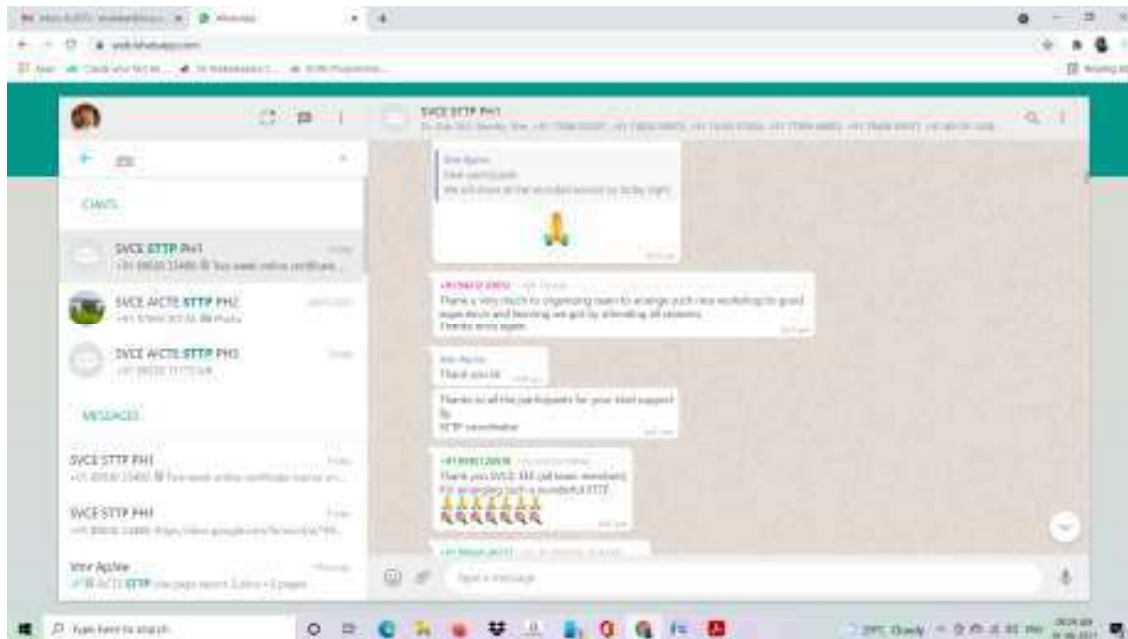
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3	MAADHURI M	Assistant Professor	EEE	Sri Venkateswara College of engineering Sriperumbudur
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78	S.SANKAR GANESH	Assistant Professor	ECE	PSR ENGINEERING COLLEGE
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PARTICIPANTS FEEDBACK



CONCLUSION

The AICTE sponsored STTP on “Electric Vehicle Evolution – Impact on Power Grid” was organized in online mode in three phases with 18 sessions per phase. The STTP phases were inaugurated by dignitaries from Tamil Nadu Generation and Distribution Corporation Limited (TANGEDCO). The sessions were handled by expert speakers from industry and academia. The sessions were of expert lectures and hands-on training that facilitated the participants from industry and academia to expertise in concepts related to EV configuration/ components and its interaction with power grid, impact of EV evolution on operation and control of Electrical Power System, charging/discharging of aggregated EV and its impact on micro grid and hands-on training in design and analysis of EV drive motor using MAGNET, simulation of EV with battery energy storage (BES) using DIgSILENT. The participants attended a MCQ test at the end of the STTP. A total of 206 participants were qualified as per the AICTE norms and were awarded with the Participation Certificates. The feedback from the participants were overwhelming in terms of the session topics & expert speakers, the session flow, hands-on training and coordination and organizing of the STTP.

APPENDICES

Department of Electrical & Electronics Engineering

AICTE sponsored six days online Short Term Training Programme (STTP)

On

“ELECTRIC VEHICLE EVOLUTION - IMPACT ON POWER GRID”

Phase-I: February 8th to 13th 2021 Phase-II: March 22nd to 27th 2021

Phase-III: April 19th to 24th 2021

Chief Patron

Dr. M. Sivanandham, Secretary, SVEHT

Patron

Dr. S. Ganesh Vaidyanathan, Principal

Convener

Dr. KR. Santha, Vice-Principal

Coordinators

Dr. KR. Santha, Professor & Head / Dept. of EEE

Dr. S. G. Bharathidasan, Asso. Professor/EEE

Dr. M. Sankar, Asst. Professor/EEE

Mr. S. Kumaravel, Asst. Professor/EEE

Mr. S. S. Sethuraman, Asst. Professor/EEE

Mr. S. Thamizmani, Asst. Professor/EEE

ABOUT THE INSTITUTION

Sri Venkateswara College of Engineering (SVCE), a premier self-financing Engineering College was started in the year 1985 and is managed by Sri Venkateswara Educational and Health Trust. The college conducts 11 B.E / B.Tech Degree Courses and 8 PG Courses in Engineering. The college has 11 Research Centers approved by Anna University cater to MS (by Research) and PhD programmes. The courses are approved by AICTE and affiliated to Anna University, Chennai. The college received Autonomous status in 2016. The college is accredited by National Assessment and Accreditation Council (NAAC). The college is situated in serene environment about 37 km from Chennai and situated on the way of Chennai – Bangalore National Highway (NH4) at Pennalur, Sriperumbudur, in Kanchipuram district.

ABOUT THE DEPARTMENT

The Department of EEE was started in the year 1994. The post graduate program (M.E) in Power Electronics and Drives was started in 2002. The department has secured permanent affiliation with Anna University and accredited by National Board of Accreditation (NBA) for the third consecutive time of Full Accreditation for five years. The Department has well equipped state-of-the-art laboratories and recognized as a Research Centre by Anna University. The Department has well qualified and experienced faculty and staff of proven ability and profound skills.

ABOUT THE STTP

The future Electrical Power System operation and control has to be restructured to face the challenges of plug-in Electric Vehicles (EV) evolution. The knowledge in EV drive, Battery Energy Storage (BES), Fast-charging circuitry, Battery Management System (BMS) and its impact on smart and micro grid dynamics, coordinated BMS, control, protection and communication protocols are imperative for Engineers working in these domains. This STTP is aimed at training the participants on the present procedures and future expectations in the aforementioned areas by experts from Industry & Institutions. This STTP will also facilitate the participants to acquire hands-on training in this field through various related systems modeling and simulation. After attending workshop, Participants will be able to select and design suitable motors, Battery management system and power converters for Electric Vehicles. They can also identify the changes to be done in Power System after EV incorporation in Micro and Smart grid environments.

OBJECTIVES

- ❖ Familiarize the participants about EV configuration/ components and its interaction with power grid.
- ❖ Creating awareness on impact of EV evolution on operation and control of Electrical Power System.
- ❖ Inculcate charging/discharging of aggregated EV and its impact on micro grid.
- ❖ Training the delegates in design and analysis of EV drive motor using MAGNET, simulation of EV with battery energy storage (BES) using PWSIM, MATLAB and DIgSILENT.
- ❖ Offering expertise to the participants on operation of micro and smart grids with EV.

STTP TOPICS

- ❖ EV evolution - Challenges to Power System Operation and Control - Utility Preparedness
- ❖ Configuration and components of EV-Overview
- ❖ EV drive motor design aspects - Hands on session using MAGNET software
- ❖ Electric Vehicle Charging Station Requirements and Battery Management Systems (BMS)
- ❖ Battery Energy Storage Technologies for Electric Vehicle and Issues in Integration with Power Grid
- ❖ Electric Vehicle and Power System Operation and Control - a perspective
- ❖ Coordination of multiple EVs, Renewable Energy Sources and Battery Energy Storage Systems in Smart Grid
- ❖ Impact of EV Evolution on Electrical Power System Dynamics
- ❖ Design and implementation of controllers and control strategies for Electric Vehicle
- ❖ Electric Vehicle add-on micro-grid - Protection studies
- ❖ Hands on Training on Micro/Smart grid Power System using DIgSILENT
- ❖ Smart Grid controls - Operation and Control with Electric Vehicle
- ❖ Electric Vehicle – Future perspectives and preparedness
- ❖ Hands on Training to realize the impact of Electric Vehicle on Power System Dynamics

INDUSTRY RESOURCE PERSONS

Mr.S.Sankara Narayanan, General Manager, Tamilnadu Energy Development Agency, Govt. of Tamilnadu
Mr.S.Jayakrishnan, General Manager, Hyundai Motor India Ltd
Dr.R.Kathiravan, AEE, TANGEDCO, TNEB
Dr.S.Sudhakar, Senior Scientist, CSIR - Central Electrochemical Research Institute, Karaikudi
Dr.N.Sivakumar, Global Technical lead, Rolls-Royce, Singapore.
Mr.Nandhakumar, Design Engineer, Power Grid Corporation of India.
Dr.B.Chandra Sekhar, Technical Lead, TCS, Bangalore.
Mr.B.Saravanan, Lead-Traction control, Alstom, Bangalore.
Dr.A.Deepak, EM Design Engineer, ePropelled systems Pvt Ltd.
Dr.V.P. Boopathi, Sr. Appn. Engineer, PWSIM Engg. Solns Pvt Ltd.
Mr.Balasubramanian Ananthraman, Scientist, CSIR - Central Electrochemical Research Institute, Chennai

ACADEMIC RESOURCE PERSONS

Dr.K.Shanti Swarup, Professor, Indian Institute of Technology Madras.
Dr. R.Jayashri, Professor, School of Electrical Engineering and Telecommunications, UNSW SYDNEY, AUSTRALIA.
Dr.R.P.Kumudinidevi, Professor, EEE Dept, Anna University Chennai.
Dr.D.Kalpana, Asst. Prof., Dept. of Instrumentation Engg, Madras Institute of Technology.
Dr.S.Kumaravel, Asso. Prof., EEE Dept., National Institute of Technology, Calicut.
Dr.P.Raja, Asso. Prof., EEE Dept., National Institute of Technology, Tiruchirappalli.
Dr.V.Gomathi, Asso. Prof., EEE Dept, Anna University, Chennai.
Dr.C.Christober Asir Rajan, Professor, EEE Dept , Pondicherry Engineering College.
Dr.D.Maharajan, Asso. Prof., EEE Dept., SRM University
Dr.V.Saravanan, Professor, EEE Dept., AEC.

ADVISORY COMMITTEE

Dr.N.K.Mohanty, Professor
Dr.Sudhakar K Bharatan, Professor
Dr.R.Karthikeyan, Asso. Professor
Dr.C.Gopinath, Asso. Professor

ORGANIZING COMMITTEE

Ms. S.Arulmozhi AP/EEE
Ms.M.Sasikala AP/EEE
Ms. N.Shanmugavadivu AP/EEE
Mr.C.Venkatesan AP/EEE
Ms.K.Suganthi AP/EEE
Mr.S.Sudharsanam AP/EEE
Dr.T.Annamalai AP/EEE

Ms.D.Amudhavalli AP/EEE
Mr.M.Ranjithkumar AP/EEE
Mr.D.S.Purushothaman AP/EEE
Ms.S.Anitha AP/EEE
Ms.S.Sinthamani AP/EEE
Ms.K.S.Pavithra AP/EEE
Mr.V.Mohanraj AP/EEE

Mr.G.Vinoth kumar AP/EEE
Ms.M.Rajalakshmi AP/EEE
Mr.C.Kamal AP/EEE
Ms.M.Maadhuri AP/EEE
Dr.R.Kannadasan AP/EEE

ELIGIBILITY

This AICTE sponsored STTP is open to Faculty members of AICTE approved Institutions, Research scholars and persons from Industries from all over the country. As per AICTE guidelines no registration fee will be charged from the participants.

Registration link: <https://forms.gle/cEdKcypoasR51xM18>

Scan QR Code



CERTIFICATE

A test shall be conducted by Project Monitoring Committee (PMC) at the end of the STTP and the certificates shall be issued to those participants who have attended all the sessions of the STTP and have qualified in the test. The number of participants will be limited to 100 for each Phase. Online meeting link will be sent to Whatsapp contact /Registered email. [For any queries: svceesttp2021@gmail.com](mailto:svceesttp2021@gmail.com)

ADDRESS FOR COMMUNICATION

The Co-ordinator,
AICTE-EEE-STTP,
Department of Electrical and Electronics Engineering,
Sri Venkateswara College of Engineering,
Irungattukottai post, Pennalur,
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“ELECTRIC VEHICLE EVOLUTION - IMPACT ON POWER GRID”

8th February 2021, 09.30 AM

Mr.S.Sankara Narayanan,

*General Manager, Tamilnadu Energy Development Agency,
Govt. of Tamilnadu*

will inaugurate and deliver the inaugural address

Dr.S.Ganesh Vaidyanathan,

Principal, Sri Venkateswara College of Engineering

will preside over the function

AICTE sponsored six days online Short Term Training Programme (STTP) on

“ELECTRIC VEHICLE EVOLUTION - IMPACT ON POWER GRID”

AGENDA

8th February 2021

09.30 – 09.33 AM :	Invocation	
09.33 – 09.43 AM :	Welcome address & About the STTP	Dr. KR.Santha, Vice Principal, Professor & Head / EEE SVCE
09.43 – 09.53 AM :	Presidential Address	Dr. S. Ganesh Vaidyanathan, Principal, SVCE
09.53 – 09.55 AM:	Introduction of Chief Guest	Dr S.G.Bharathidasan Asso.Professor/EEE SVCE
09.55 AM onwards:	Inaugural address & STTP Session 1	Mr.S.Sankara Narayanan, <i>General Manager,</i> <i>Tamilnadu Energy Development Agency, Govt. of Tamilnadu</i>
<u>Topic:</u> Impact of Renewable Energy Generation and Electric Vehicle on Power Grid – Future perspective and Preparedness		
10.55 AM :	Vote of thanks	Dr M.Sankar AP/EEE SVCE

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Phase-I SCHEDULE :: February 8th to 13th 2021

Date and day	Session #1 9:30 am to 11:00 am		Session #2 11:15 am to 12:45 pm		Session #3 2:00 pm to 3:30 pm
08/02/2021 Monday	INAUGURATION followed by Expert Lecture Expert: Mr.S.Sankara Narayanan, General Manager, Tamilnadu Energy Development Agency, Govt. of Tamilnadu Topic: Impact of Renewable Energy Generation and Electric Vehicle on Power Grid – Future perspective and Preparedness	Refreshment break (11:00 am to 11:15 am)	Expert: Dr.N.Sivakumar, Global Technical lead, Rolls-Royce, Singapore Topic: Configuration and components of Electric Vehicle - Overview	Lunch break (12:45 pm to 2:00 pm)	Expert: Dr.A.Deepak, EM Design Engineer, ePropelled systems Pvt Ltd. Topic: EV drive motor design aspects - Hands on session using MAGNET software
09/02/2021 Tuesday	*10.00 am to 11.30 am Expert: Dr.B.Chandra Sekhar, Technical Lead, Tata Consultancy Services, Bangalore. Topic: Electric Vehicle Charging Station Requirements and Battery Management Systems (BMS)		Expert : Dr K.Rathnakannan Associate Professor Department of EEE College of Engineering, Guindy Anna University, Chennai. Topic: Design and implementation of controllers and control strategies for Electric Vehicle		Expert: Dr.S.Sudhakar, Senior Scientist, CSIR - Central Electrochemical Research Institute, Karaikudi Topic: Li-ion batteries : Recent Progress and Challenges
10/02/2021 Wednesday	Expert: Dr.K.Shanti Swarup, Professor, Indian Institute of Technology Madras Topic: Electric Vehicle and Power System Operation and Control - a perspective		Expert: Dr.S.Kumaravel, Asso. Prof., EEE Dept., National Institute of Technology, Calicut Topic: Coordination of multiple Electric Vehicles, Renewable Energy Sources and Battery Energy Storage Systems in Smart Grid		Expert: Dr.Venkatakrithiga, Asso. Prof., EEE Dept., National Institute of Technology, Trichy Topic: Impact of Electric Vehicle in Deregulated Environment

11/02/2021 Thursday	Expert: Dr.P.Raja, <i>Asso. Prof., EEE Dept., National Institute of Technology, Tiruchirappalli</i> Topic: Electric Vehicle add-on micro-grid - Protection studies	Expert: Dr.V.Saravanan, <i>Professor, EEE Dept., AEC.</i> Topic: Battery Energy Storage Technologies for Electric Vehicle and Issues in Integration with Power Grid	Expert: Dr.D.Maharajan, <i>Asso. Prof., EEE Dept., SRM University</i> Topic: Hands on Training on Micro/Smart grid Power System using DIgSILENT
12/02/2021 Friday	Expert: Dr.V.Gomathi, <i>Asso. Prof., EEE Dept, Anna University, Chennai.</i> Topic: Smart Grid controls - Operation and Control with Electric Vehicle	Expert: Dr. R.Jayashri, <i>Professor, School of Electrical Engineering and Telecommunications, UNSW SYDNEY, AUSTRALIA.</i> Topic: Electric vehicle impact on Power System Dynamics	Expert: Mr.Nandhakumar, <i>Design Engineer, Power Grid Corporation of India.</i> Topic: Vision 2050 : Power Grid Resiliency
13/02/2021 Saturday	*9.00 am to 10.30 am Expert: Mr.S.Jayakrishnan, <i>General Manager, Hyundai Motor India Ltd</i> Topic: Electric Vehicle – Future perspectives and preparedness	Expert: Dr.C.Christober Asir Rajan, <i>Professor, EEE Dept , Pondicherry Engineering College</i> Topic: Optimization of Vehicle Energy flow with Residential Grid and Renewable Energy Sources	Expert: Dr.V.P. Boopathi, <i>Sr. Appn. Engineer, PWSIM Engg. Solns Pvt Ltd.</i> Topic: Hands on Training to realize the impact of Electric Vehicle on Power System Dynamics



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22nd March 2021, 09.30 AM

Er.C.Veeramani,

*Chief Engineer Regulatory Cell (Retired),
TANGEDCO*

will inaugurate and deliver the inaugural address

Dr.S.Ganesh Vaidyanathan,

Principal, Sri Venkateswara College of Engineering

will preside over the function

AICTE sponsored six days online Short Term Training Programme (STTP) on

“ELECTRIC VEHICLE EVOLUTION - IMPACT ON POWER GRID”

AGENDA

22nd March 2021

09.30 – 09.33 AM :	Invocation	
09.33 – 09.43 AM :	Welcome address & About the STTP	Dr.KR.Santha, Vice Principal, Professor & Head / EEE SVCE
09.43 – 09.53 AM :	Presidential Address	Dr.S.Ganesh Vaidyanathan, Principal, SVCE
09.53 – 09.55 AM:	Introduction of Chief Guest	Dr.S.G.Bharathidasan Asso. Professor/EEE, SVCE
09.55 AM onwards:	Inaugural address & STTP Session 1	Er.C.Veeramani, <i>Chief Engineer Regulatory Cell (Retd), TANGEDCO</i>
<i>Topic: Impact of Renewable Energy Generation and Electric Vehicle on Power Grid – Future perspective and Preparedness</i>		
10.55 AM :	Vote of thanks	Dr.M.Sankar AP/EEE, SVCE

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Phase-II SCHEDULE :: March 22nd-27th,2021

Date and day	Session #1 9:30 am to 11:00 am		Session #2 11:15 am to 12:45 pm		Session #3 2:00 pm to 3:30 pm
22/03/2021 Monday	INAUGURATION followed by Expert Lecture Expert: Dr.Veeramani <i>Chief Engineer (Retd), TANGEDCO</i> Topic: Impact of Renewable Energy Generation and Electric Vehicle on Power Grid – Future perspective and Preparedness		Expert : Dr . Sankara Narayanan Professor & Head <i>EEE Dept., National Institute of Technology, Tiruchirappalli</i> Topic: Power Train Design		Expert : Dr.Nalin Kant Mohanty <i>Professor, EEE Dept, SVCE.</i> Topic: Yoga for Teachers Expert: Dr.S.G.Bharathidasan <i>Asso. Prof., EEE Dept., SVCE.</i> Topic: Smart Grid with Electric Vehicle
23/03/2021 Tuesday	Expert: Dr.B.Chandra Sekhar, <i>Technical Lead, Tata Consultancy Services, Bangalore.</i> Topic: Electric Vehicle Charging Station Requirements and Battery Management Systems (BMS)	Refreshment break (11:00 am to 11:15 am)	Expert : Dr S. Kalpana Asst. Professor, Madras Institute of Technology, Chrompet. Anna University, Chennai. Topic: Design and implementation of controllers and control strategies for Electric Vehicle	Lunch break (12:45 pm to 2:00 pm)	Expert: Dr.S.Sudhakar, <i>Senior Scientist, CSIR - Central Electrochemical Research Institute, Karaikudi</i> Topic: Li-ion batteries : Recent Progress and Challenges
24/03/2021 Wednesday	Expert: Dr.P.Raja, <i>Asso. Prof., EEE Dept., National Institute of Technology, Tiruchirappalli</i> Topic: Electric Vehicle add-on micro-grid - Protection studies		Expert: Dr.S.Kumaravel, <i>Asso. Prof., EEE Dept., National Institute of Technology, Calicut</i> Topic: Coordination of multiple Electric Vehicles, Renewable Energy Sources and Battery Energy Storage Systems in Smart Grid		Expert: Dr. S.Chandramohan, <i>Prof. & HOD/EEE Dept., College of Engineering, Guindy, Anna University, Chennai.</i> Topic: Impact of Electric Vehicle in Deregulated Environment

25/03/2021 Thursday	Expert: Dr. R.P.Kumudini Devi, Professor, College of Engineering, Guindy. Anna University, Chennai-25 Topic: Electric Vehicle and Power System Operation and Control - a perspective	Expert: Dr.V.Saravanan, Professor, EEE Dept., AEC. Topic: Battery Energy Storage Technologies for Electric Vehicle and Issues in Integration with Power Grid	Expert: Dr.A.Deepak, EM Design Engineer, ePropelled systems Pvt Ltd. Topic : EV drive motor design aspects - Hands on session using MAGNET software
26/03/2021 Friday	Expert: Dr. R.Jayashri, Professor, School of Electrical Engineering and Telecommunications, UNSW SYDNEY, AUSTRALIA. Topic: Electric vehicle impact on Power System Dynamics	Expert: Dr.N.Sivakumar, Global Technical lead, Rolls- Royce, Singapore Topic: Configuration and components of Electric Vehicle - Overview	Expert: Dr.D.Maharajan, Asso. Prof., EEE Dept., SRM University Topic: Hands on Training on Micro/Smart grid Power System using DIgSILENT
27/03/2021 Saturday	Expert: Mr.B.Saravanan, Lead-Traction control, Alstom, Bangalore Topic: Electric Traction	Expert: Dr.P.Somasundaram Prof./EEE Dept., College of Engineering, Guindy, Anna University, Chennai. Topic: Optimization of Vehicle Energy flow with Residential Grid and Renewable Energy Sources	Expert: Dr.V.P. Boopathi, Sr. Appn. Engineer, PWSIM Engg. Solns Pvt Ltd. Topic: Hands on Training to realize the impact of Electric Vehicle on Power System Dynamics



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POWER GRID”**

19th April 2021, 9.30 AM

Dr.R.Kathiravan,

Executive Engineer, TANGEDCO

will inaugurate and deliver the inaugural address

Dr.S.Ganesh Vaidyanathan,

Principal, Sri Venkateswara College of Engineering

will preside over the function

AGENDA

19th April 2021

09.30 – 09.33 AM :	Invocation	
09.33 – 09.43 AM :	Welcome address & About the STTP	Dr. KR.Santha, Vice Principal, Professor & Head / EEE
09.43 – 09.53 AM :	Presidential Address	Dr. S. Ganesh Vaidyanathan, Principal, SVCE
09.53 – 09.55 AM :	Introduction of Chief Guest	Dr. S.G.Bharathidasan Associate Professor / EEE
09.55 AM onwards :	Inaugural address & STTP session #1	Dr.R.Kathiraven Executive Engineer, TANGEDCO
	Topic:	<i>“Impact of Renewable Energy Generation and Electric Vehicle on Power Grid – Future perspective and Preparedness”</i>
10.55 AM :	Vote of thanks	Dr.M.Sankar Asst. Prof./EEE

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Phase-III SCHEDULE :: April 19th-24th, 2021

Date and day	Session #1 9:30am to 11:00am		Session #2 11:15am to 12:45pm		Session #3 2:00pm to 3:30pm
19/04/2021 Monday	INAUGURATION & Expert Lecture Expert: Dr.R.Kathiravan <i>Executive Engineer, TANGEDCO.</i> Topic: Impact of Renewable Energy Generation and Electric Vehicle on Power Grid – Future perspective and Preparedness	Refreshment break (11:00am to 11:15am)	Expert: Dr.Sankara Narayanan <i>Professor & Head EEE Dept., National Institute of Technology, Tiruchirappalli</i> Topic: Power Train Design	Lunch break (12:45pm to 2:00pm)	*(1:30 pm to 2:30 pm) Expert: Dr.V.Saravanan, <i>Professor, EEE Dept., AEC.</i> Topic: Electric Vehicle and Issues in Integration with Power Grid
20/04/2021 Tuesday	*(10:00 am to 11:15 pm) Expert: Dr.B.Chandra Sekhar, <i>Technical Lead, Tata Consultancy Services, Bangalore.</i> Topic: Electric Vehicle Charging Station Requirements and Battery Management Systems (BMS)		Expert: Dr K.Rathnakannan <i>Associate Professor, Dept. of EEE College of Engineering, Guindy Anna University, Chennai.</i> Topic: Design and implementation of controllers and control strategies for Electric Vehicle		*(2:30pm to 3:30 pm) Expert: Dr.S.G Bharathidasan <i>Asso. Prof., SVCE</i> Topic: Optimization of Vehicle Energy flow with Residential Grid and Renewable Energy Sources
21/04/2021 Wednesday	Expert: Dr.P.Raja, <i>Asso. Prof., EEE Dept., National Institute of Technology, Tiruchirappalli</i> Topic: Electric Vehicle add-on micro-grid - Protection studies		Expert: Dr.S.Kumaravel, <i>Asso. Prof., EEE Dept., National Institute of Technology, Calicut</i> Topic: Coordination of multiple Electric Vehicles, Renewable Energy Sources and Battery Energy Storage Systems in Smart Grid		Expert: Dr.Venkatakrithiga, <i>Asso. Prof., EEE Dept., National Institute of Technology, Trichy</i> Topic: Impact of Electric Vehicle in Deregulated Environment

22/04/2021 Thursday	Expert: Dr.R.Jayashri, <i>Professor, School of Electrical Engineering and Telecommunications, UNSW SYDNEY, AUSTRALIA.</i> Topic: Electric vehicle impact on Power System Dynamics	Expert: Dr.A.Deepak, <i>EM Design Engineer, ePropelled systems Pvt Ltd.</i> Topic : EV drive motor design aspects - Hands on session using MAGNET software	Expert:Mr.Rathnakumar Devaraj, <i>Industrial & Systems, Development Engineer, CE+T Power, Wandre, Belgium.</i> Topic: Modular Multidirectional Converter& Application.
23/04/2021 Friday	Expert : Dr.V.Gomathi, <i>Asso. Prof., EEE Dept, Anna University, Chennai.</i> Topic: Smart Grid controls - Operation and Control with Electric Vehicle	Expert: Dr.N.Sivakumar, <i>Global Technical lead, Rolls-Royce, Singapore</i> Topic: Configuration and components of Electric Vehicle - Overview	Expert: Dr.D.Maharajan, <i>Asso. Prof., EEE Dept., SRM University</i> Topic: Hands on Training on Micro/Smart grid Power System using DIgSILENT
24/04/2021 Saturday	Expert: Mr.S.Jayakrishnan, <i>General Manager, Hyundai Motor India Ltd</i> Topic: Electric Vehicle – Future perspectives and preparedness	Expert: Dr.R.P.Kumudini Devi, <i>Professor, College of Engineering, Guindy. Anna University, Chennai-25</i> Topic: Electric Vehicle and Power System Operation and Control - a perspective	Expert: Dr.V.P.Boopathi, <i>Sr. Appn. Engineer, PWSIM Engg. Solns Pvt Ltd.</i> Topic: Hands on Training to realize the impact of Electric Vehicle on Power System Dynamics





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**“ELECTRIC VEHICLE EVOLUTION - IMPACT
ON POWER GRID”**

by

Dr.KR.Santha

**Vice Principal, Professor & Head/EEE
Sri Venkateswara College of Engineering
Sriperumbudur**

Date : 24-04-2021 (Saturday)

Time : 3.30 PM

Venue : <https://meet.google.com/rdq-uqtx-tkj>





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This is to certify that

Dr. / Mr. / Ms. M. SANKAR, Assistant Professor, EEE
of

SRI VENKATESWARA COLLEGE OF ENGINEERING SRIPERUMBUDUR

has attended Six days online Short Term Training Programme - Phase II on **“Electric Vehicle Evolution - Impact on Power Grid”** Organised by Department of Electrical and Electronics Engineering,
Sri Venkateswara College of Engineering during March 22nd - 27th, 2021.

Dr. K R. Santha

**Vice Principal, Prof & Head / EEE
Co-ordinator**

**Prof. Dr. S Ganesh Vaidyanathan
Principal**



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