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KINGS COLLEGE OF ENGINEERING

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DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING
ACADEMIC YEAR 2022-23 ODD

Internal Seminar – Report

Title of the seminar : Multilevel Inverters for Electric Vehicle Applications

Date : 25.11.2022

Resource Person : Dr.P.Narasimman, AP/EEE, KCE

Beneficiaries : IV-EEE, III-EEE & II-EEE – 80 Students

Venue **:** EEE**-** Smart Classroom

The Department of EEE organized an Internal Seminar on **"**Multilevel Inverters for Electric Vehicle Applications**"** for second, third and final year EEE students on 25.11.2022. The main objective of the internal seminar is:

- To impart knowledge to students on recent developments and technological advancements in the field of Electrical and Electronics Engineering.
- To facilitate the use of multilevel inverter in their projects and seminar presentations.

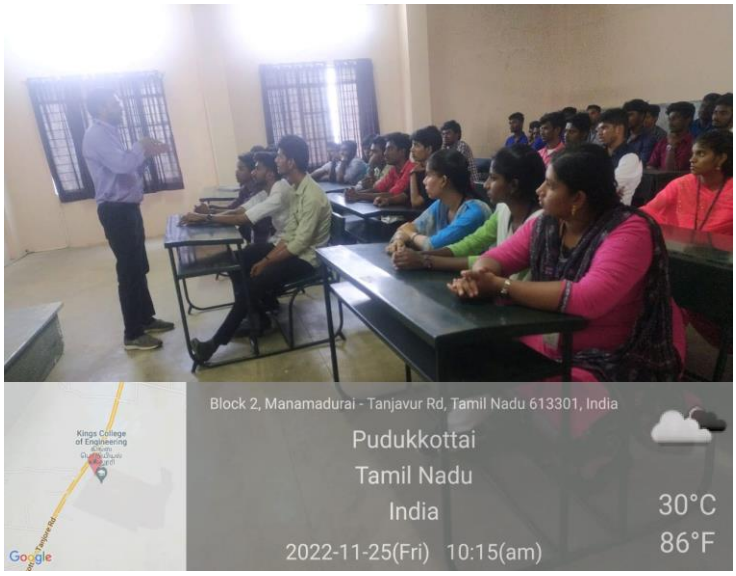
The following points were discussed during the session:

- Introduction and need for Electric Vehicle
- Types of electric vehicles
- Comparison of BEV, HEV, and FCEV
- Major Components of Electric Vehicle
- Introduction about DC-link voltage
- Advantages and drawbacks of high DC-link voltage
- Introduction about Multilevel Inverter and its types

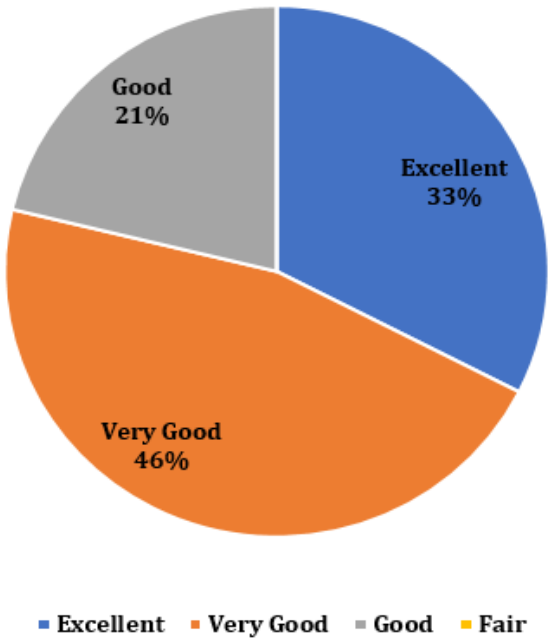
Outcome:

- Students can realize the impact of different types on the electric vehicle.
- Students are able to understand the concepts and operation of multilevel inverter, their applications and their advantages over conventional inverter.
- Students can select multilevel inverter for their project work, research publication, conference presentation and PCE activities.

Snapshot from Seminar



Feedback Analysis:



References:

1. P. Omer, J. Kumar, and B. S. Surjan, ``A review on reduced switch count multilevel inverter topologies,'' IEEE Access, vol. 8, pp. 22281_22302, 2020.
2. C. Dhanamjayulu, S. R. Khasim, S. Padmanaban, G. Arunkumar, J. B. Holm-Nielsen, and F. Blaabjerg, ``Design and implementation of multilevel inverters for fuel cell energy conversion system,'' IEEE Access, vol. 8, pp. 183690_183707, 2020, doi: 10.1109/ACCESS.2020.3029153.
3. C. Dhanamjayulu and S. Meikandasivam, ``Implementation and comparison of symmetric and asymmetric multilevel inverters for dynamic loads,''IEEE Access, vol. 6, pp. 738_746, 2018.
4. C. Dhanamjayulu and S. Meikandasivam, ``Performance verification of symmetric hybridized cascaded multilevel inverter with reduced number of switches,'' in Proc. Innov. Power Adv. Comput. Technol. (i-PACT), Vellore, India, Apr. 2017, pp. 1_5.
5. M. D. Siddique, S. Mekhilef, N. M. Shah, A. Sarwar, A. Iqbal, and M. A. Memon, ``A new multilevel inverter topology with reduce switch count,'' IEEE Access, vol. 7, pp. 58584_58594, 2019.
6. M. Khenar, A. Taghvaie, J. Adabi, and M. Rezanejad, ``Multi-level inverter with combined T-type and cross-connected modules,'' IET Power Electron., vol. 11, no. 8, pp. 1407_1415, 2018.

Faculty In-Charge

HOD/EEE

Principal

Slides

MULTILEVEL INVERTERS FOR ELECTRIC VEHICLE APPLICATIONS

Dr.P.NARASIMMAN, M.E., Ph.D,
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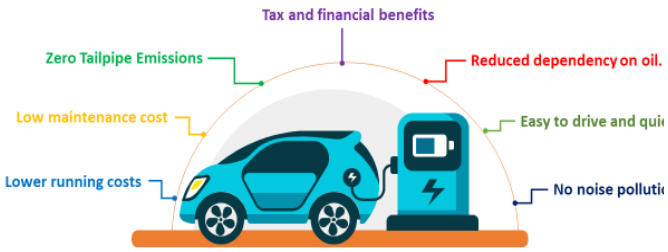
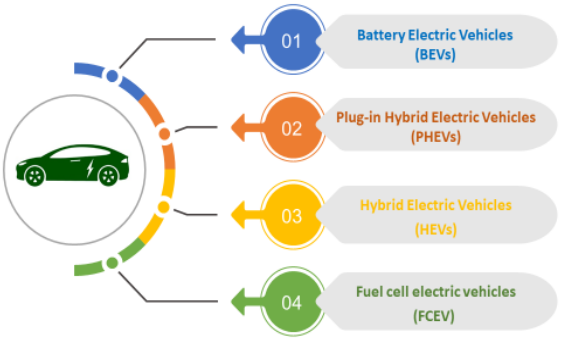
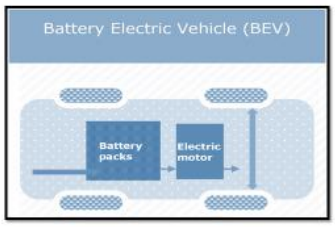
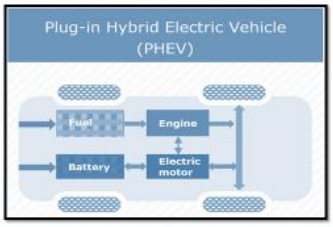
Why we need electric vehicles?

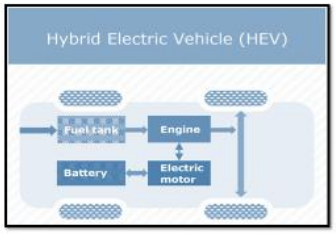


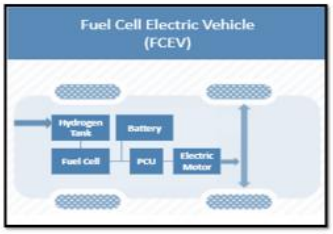
Types of Electric Vehicles











Comparison of BEV, HEV, and FCEV

Types of EVs	BEV	HEV	FCEV
Propulsion	• Electric motor drives	• Electric motor drives • ICE	• Electric motor drives
Energy System	• Battery • Ultracapacitor	• Battery • Ultracapacitor • ICE generating unit	• Fuel cells
Energy Source and Infrastructure	• Electric grid charging facilities	• Gasoline stations • Electric grid charging facilities (optional for plug-in hybrid)	• Hydrogen • Methanol or gasoline • ethanol
Characteristics	• Zero emission • Independence on fossil oil • Commercially available	• Low emission • Higher fuel economy • Commercially available	• Zero emission Independence on fossil oil • High energy efficiency • Under development (future trend)
Major Issues	• Limitation of battery • Short range(100-200km) • Charging facilities	• Dependence on fossil fuel • complex	• High fuel cell cost • Lack of infrastructure

Disadvantages of Electric Vehicle

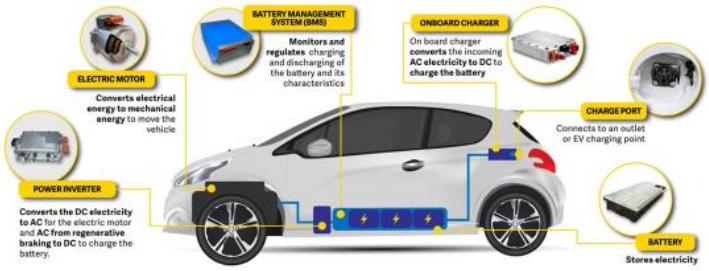
Electric cars are more expensive

Recharging takes long times

Short travelling distance

Not enough charging stations

Major Components of Electric Vehicle

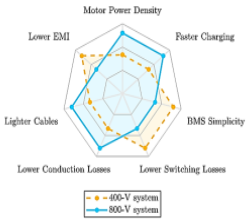


Higher DC-Link Voltage

Battery Voltage of some EVs on the market

Vehicle	First Production Year	Battery Voltage (V)
Nissan Leaf	2010	350
Tesla Model S	2012	350
Chevrolet Spark EV	2013	400
Audi e-tron	2018	400
Porsche Taycan	2019	800
Lucid Air	2020	900

Advantages and drawbacks of increasing DC-link voltage

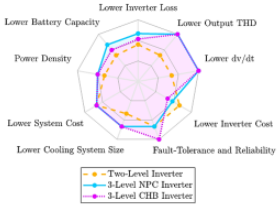


Multilevel Inverter

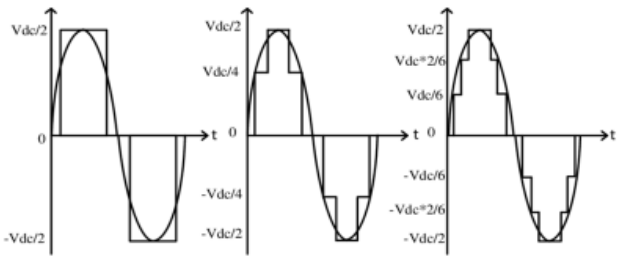
Traction Inverter's Structure on the Market

Application	DC Voltage (V)	Structure	Switching Devices
Electric Ships	1.5kV to 15kV	Two-level or Multilevel	GTO ,Thyristor or IGBT
Trains and Tramways	Up to 3kV	Two-level or Three -level	GTO ,Thyristor or IGBT
Buses, Trucks	Up to 900V	Two-level	IGBT , MOSFET
Passenger EVs	Up to 900V	Two-level	IGBT , MOSFET

Comparison of different criteria in conventional two-level, three-level NPC and three-level CHB inverters



Comparison of Output Voltage Waveform



Comparison of various MLI topologies