



IIT ROORKEE



NPTEL ONLINE
CERTIFICATION COURSE

Charging Infrastructure


Lecture-1

Introduction to the EV Charging System

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Course Introduction

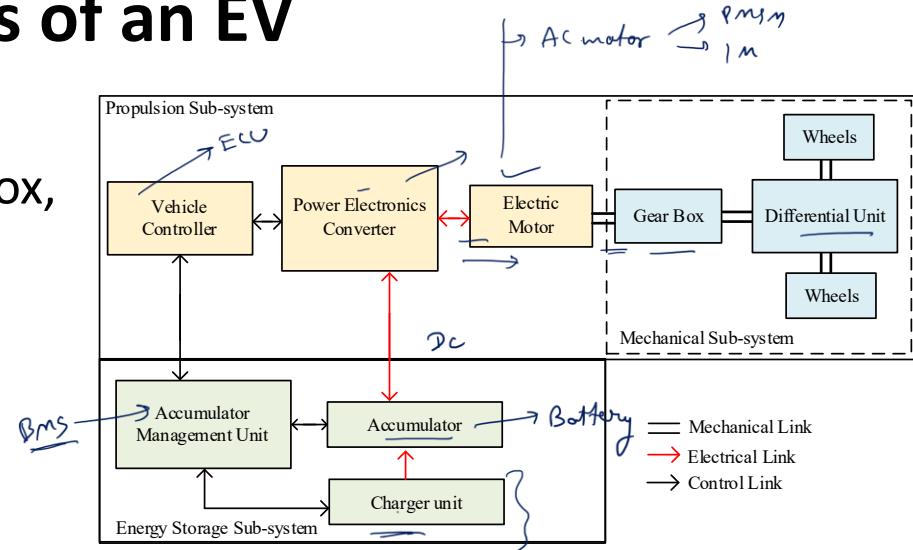
- Covers topic like
 - Introduction to EV charging system, building blocks of an AC and DC charger.
 - Types, Operating principles, design, and control of power conversion unit (AC-DC and isolated DC-DC power converter).
 - Communication aspects. 
 - Charging procedures and protocols: AC & DC charger.

CCS 2
BEV → DC001

AC type-2

Subsystems of an EV

- EV consist of following sub-systems
 - Mechanical sub-system: gearbox, differential, mechanical linkages
 - Electric motor
 - Power electronics converter
 - Vehicle Controller
 - Energy Storage sub-system (Source)
 - Vehicle Communication
 - Inter vehicle
 - Intra vehicle



Key EV Battery Information (INDIA)

Vehicle Segment	Battery Capacity	Battery Voltage
E-2W	1.2-8 kWh	48-72V
E-3W Passenger/goods	3.6-8 kWh	48-72V
E-car with LV powertrain	21 kWh	72V
E-car with HV powertrain	30-80 kWh	350-500V

Low voltage
40-120V 75% - 115%
HV (350-500V)

Data: <https://www.niti.gov.in/sites/default/files/2021-08/HandbookforEVChargingInfrastructureImplementation081221.pdf>



EV Battery Charging

- EV Battery charging can be done in the following ways:

- ★ Conductive charging: AC or DC chargers
- Contactless charging: inductive, capacitive → Static } range anxiety
- Dynamic contactless (on-road vehicle charging) charging → increased range
- Battery swapping → range is increased to ∞ (if the battery swapping stations are placed in near by distance)
→ stoppage time is minimal as compared to Conductive Charging

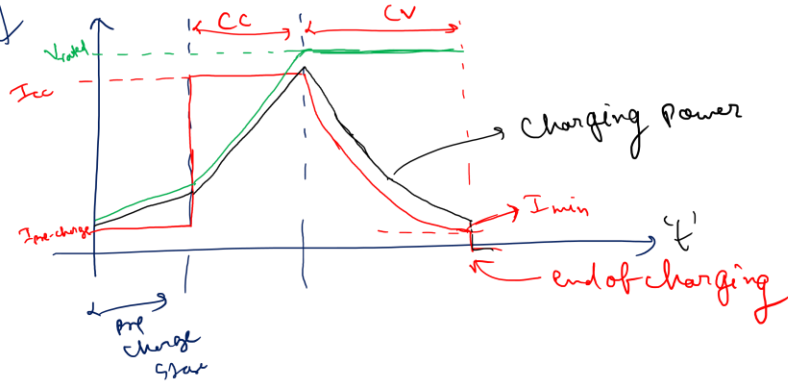
Battery Charging Modes

- Key battery charging modes are:

- CC (constant current) → charging is done with constant current → overheating
monitoring of v/g of battery is required
- CV (constant voltage) → charging is done with constant voltage → overheating
over current
- CCCV (constant current followed by constant voltage) → CC → fast charging, CV → time taking part of charging
- CPCV (constant power followed by constant voltage) → charging the battery with high currents at low SOC's and the current goes down as charging progresses

2.7V | 3.6V | 4.2V ^{115%}
75% | 35V | 48V | 55V

Legend
Current
Volt
Power



- multistep CC-CV
- Pulse charging
- variable current charging

CC-CV

Need of an EV charger

- The requirement of charging profile is determined by the battery management system (BMS).
- EV charger needs to support specific charging profile with required protection, safety, and communication (for monitoring and metering).
 - Charging is done from AC grid or uncontrolled DC source (from renewables)
 - Battery which is the DC source

Building Blocks of an EV Charger

- Basic building blocks of an EV charger

- Power Conversion unit →

- AC-DC converter, isolated DC-DC converter, Filters

- Communication Ports

- Proximity pilot, control pilot, CAN  *PLC, (A)VL, PLC modems*

- EVSE (electric vehicle supply equipment): AC, DC EVSE

- Connectors and cables:

- Charging plug from EVSE, Vehicle inlet connector
 - Cables → *5m*

→ *female plug in Vehicle*

Thank You

