# INTERNSHIP TASK REPORT

### Task 1: Automobile Systems and Electric Vehicle Technology

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## 1. Automobile Systems Explanation

An automobile is a complex integration of mechanical, electrical, and hydraulic systems designed to transport passengers or cargo. As an engineering student, it is essential to understand that while the motive power source may change (petrol vs. electric), the fundamental subsystems required for vehicle operation remain largely consistent.

The core systems of any automobile include:

- **The Chassis and Body:** The structural skeleton of the vehicle. The chassis supports the engine, wheels, and suspension, while the body provides aerodynamics and passenger safety.
- **The Powertrain:** This is the heart of the vehicle. It includes the energy source (engine or motor) and the transmission system that conveys power to the wheels.
- **The Transmission System:** This system uses gears and a drive shaft to transmit the torque generated by the engine/motor to the wheels, allowing the vehicle to move at varying speeds.
- **Suspension and Steering:** The suspension system (springs and shock absorbers) manages the interaction between the tires and the road surface, ensuring stability. The steering system converts the driver’s rotational input into the angular turn of the front wheels.
- **Braking System:** Crucial for safety, this uses hydraulic pressure to clamp brake pads against discs (or drums) to convert kinetic energy into heat, slowing the vehicle down.
- **Electrical System:** In modern vehicles, this is not just about lights and ignition. It involves the ECU (Electronic Control Unit), sensors, and infotainment. In Electric Vehicles (EVs), this becomes the primary power system.

## 2. EV Components and Working

As the industry shifts towards sustainable mobility, understanding the architecture of an Electric Vehicle (EV) is critical for electrical engineers. Unlike Internal Combustion Engine (ICE) vehicles, EVs rely entirely on electricity stored in a battery pack to drive an electric motor.

**Key Components:**

- **Battery Pack (Traction Battery):** This is the "fuel tank" of an EV. It is usually a high-voltage Lithium-Ion battery pack (typically 300V–800V) that stores DC energy. It requires a sophisticated Battery Management System (BMS) to monitor cell voltage, temperature, and state of charge (SoC).
- **Inverter:** This is a critical power electronics component. Since the battery stores Direct Current (DC) but most high-performance traction motors run on Alternating Current (AC), the inverter converts

DC to AC. It also controls the frequency and amplitude of the AC to regulate motor speed and torque.

- **Electric Motor:** The motor converts electrical energy into mechanical energy. Common types include Permanent Magnet Synchronous Motors (PMSM) or Induction Motors. These motors provide instant torque and are highly efficient (up to 95%).
- **DC-DC Converter:** The vehicle still has 12V accessories (lights, wipers, infotainment). The DC-DC converter steps down the high-voltage from the traction battery to 12V to charge the auxiliary battery and power these systems.
- **On-Board Charger (OBC):** When plugging into a standard AC socket, the OBC converts the grid's AC electricity into DC to charge the battery.
- **Thermal Management System:** Batteries and motors generate heat. A cooling system (often liquid-cooled) maintains optimal operating temperatures to prevent overheating and degradation.

**Working Principle:**

When the driver presses the accelerator, the controller (inverter) draws DC power from the battery, converts it to AC, and sends it to the motor. The motor spins, driving the transmission (usually a single-speed reduction gear) which turns the wheels. When braking, the motor acts as a generator (Regenerative Braking), converting kinetic energy back into electricity to recharge the battery.

## 3. ICE vs. EV Comparison

The following table compares traditional Internal Combustion Engine vehicles with Electric Vehicles from an engineering and operational perspective.

| Feature | Internal Combustion Engine (ICE) | Electric Vehicle (EV) |
|---|---|---|
| Power Source | Fossil Fuels (Petrol/Diesel) | Electricity (Li-Ion Battery) |
| Efficiency | Low (~20-30% thermal efficiency) | High (~85-90% energy efficiency) |
| Moving Parts | Hundreds (Pistons, valves, crankshaft) | Few (Motor, reduction gear) |
| Torque | Low at low RPM; needs gears to build up | Instant torque from 0 RPM |
| Maintenance | High (Oil changes, filters, spark plugs) | Low (Tires, wipers, cabin air filter) |
| Emissions | High tailpipe emissions ($CO_2$, $NO_x$) | Zero tailpipe emissions |
| Refueling | Fast (Minutes at a gas station) | Slow (Hours for AC, 30+ mins for DC Fast) |
| Cost | Lower upfront cost, higher running cost | Higher upfront cost, lower running cost |

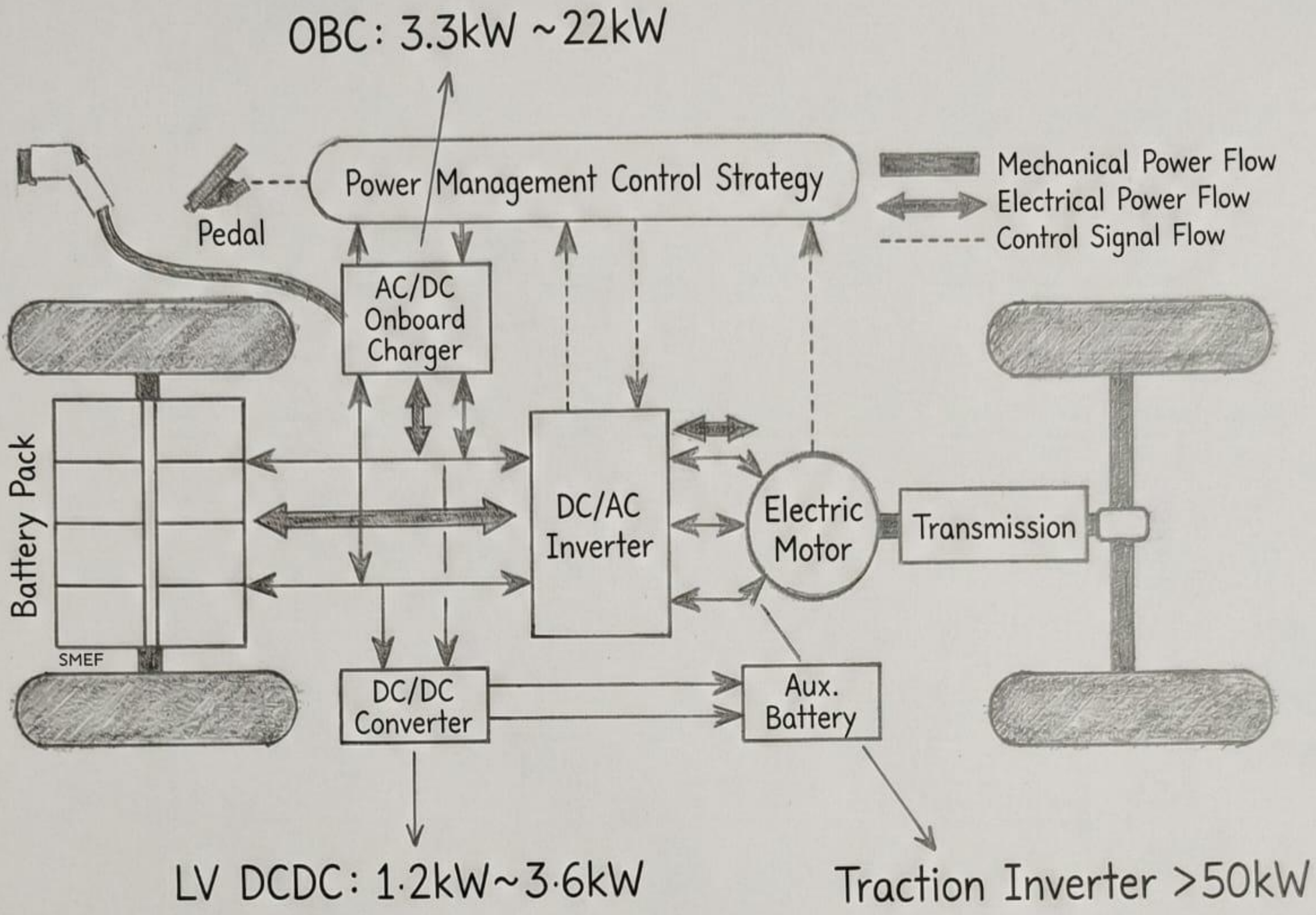
### 4. Advantages and Challenges of EVs

**Advantages:**

- **Environmental Impact:** EVs significantly reduce local air pollution and greenhouse gas emissions, especially if charged via renewable energy sources.
- **Running Costs:** The cost per kilometer for electricity is a fraction of the cost of petrol or diesel.
- **Performance:** The instant torque provides excellent acceleration and a smoother, quieter ride due to the lack of engine vibration.
- **Simplicity:** With fewer moving parts, there is less wear and tear, resulting in lower maintenance requirements.

**Challenges:**

- **Range Anxiety:** The fear of running out of charge before reaching a destination remains a primary concern for consumers, despite improvements in battery density.
- **Charging Infrastructure:** In many regions (including parts of India), the network of fast-charging stations is not yet dense enough to support long-distance travel comfortably.
- **Grid Load:** Widespread adoption of EVs will place a significant load on the electrical grid, requiring upgrades to distribution transformers and power generation.
- **Battery Disposal:** Recycling Lithium-Ion batteries at the end of their lifecycle is an environmental and technical challenge that the industry is still optimizing.




## AUTOMATIC SYSTEM LAYOUT