![CODE - Centre for Outreach and Digital Education, IIT Madras logo](logo)

CODE IIT Madras offers

MOTORS AND CONTROLLERS

Lab Course
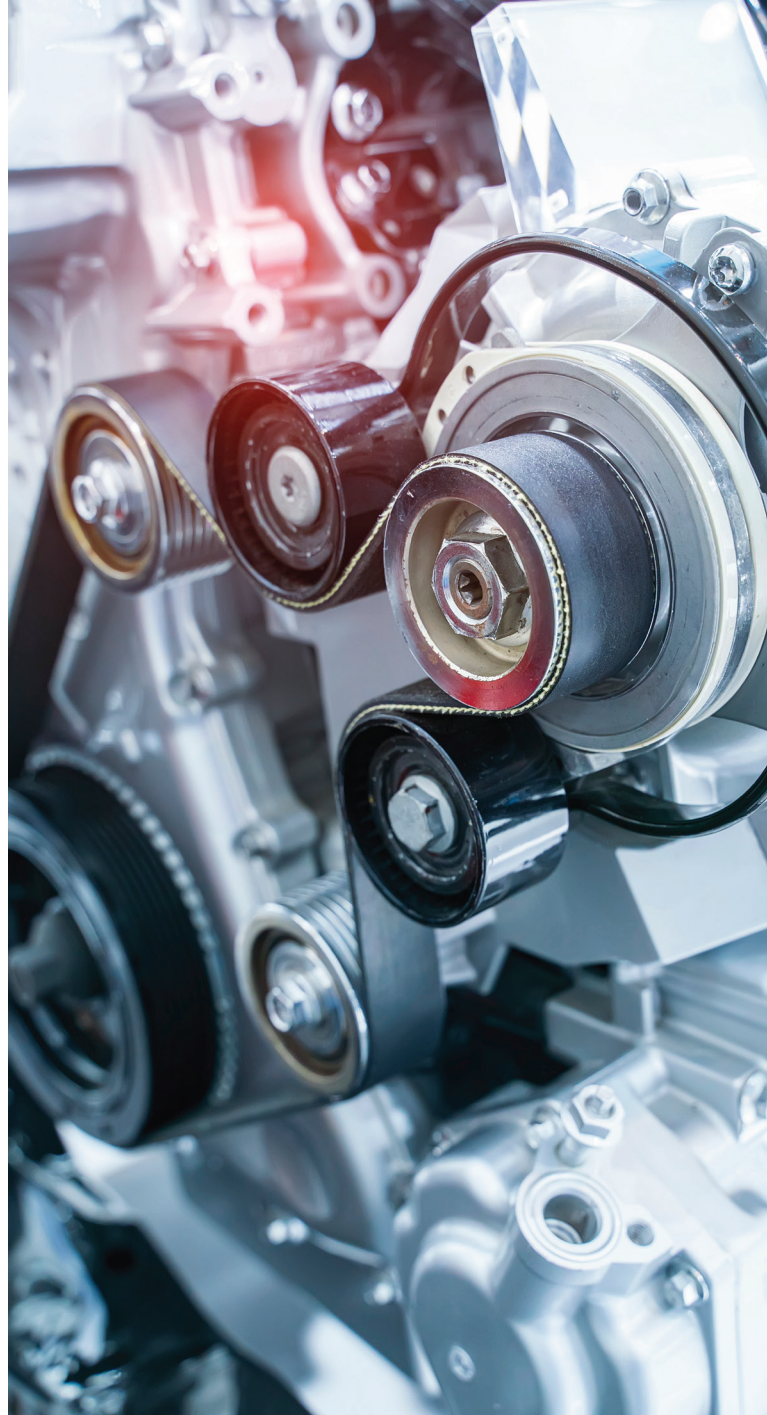
S.No	Name of the experiments	Description	No. of hours
1	Cut Section Analysis of AC and DC Motors	• Examining and studying the internal components and structure of various motors such as DC, Stepper, BLDC, PMSM, SRM etc.,	3
2	Disassembly and Assembly of AC and DC Motors	• To develop hands-on skills in safely disassembling and assembling electric motors using proper tools and techniques.	3
3	Study of three-phase DC-AC inverter	• Gain understanding of the principle of Operation of a Three-Phase DC-AC Inverter • Understand modulation techniques used for controlling the inverter, such as Sinusoidal PWM (SPWM)	2
4	Study of torque measurements using a Tandem dynamometer	• To measure the speed, torque and power output of motors • To assess the dynamic torque response of the motor under test, including transient conditions • To simulate various load conditions and study their impact on torque	2
5	Control Strategy of Electric Motors (HIL approach of testing motor and drive hardware)	• To develop and implement real-time control algorithms for BLDC, SR, PMSM, and Induction motors using Snetley FPGA	3
6	Simulation case studies 1. EV Powertrain 2. Motor Control	• To analyze the complete EV powertrain, including battery, motor, controller, and drivetrain under standard drive cycles. • To implement motor control algorithms	2

LEARNING OUTCOME

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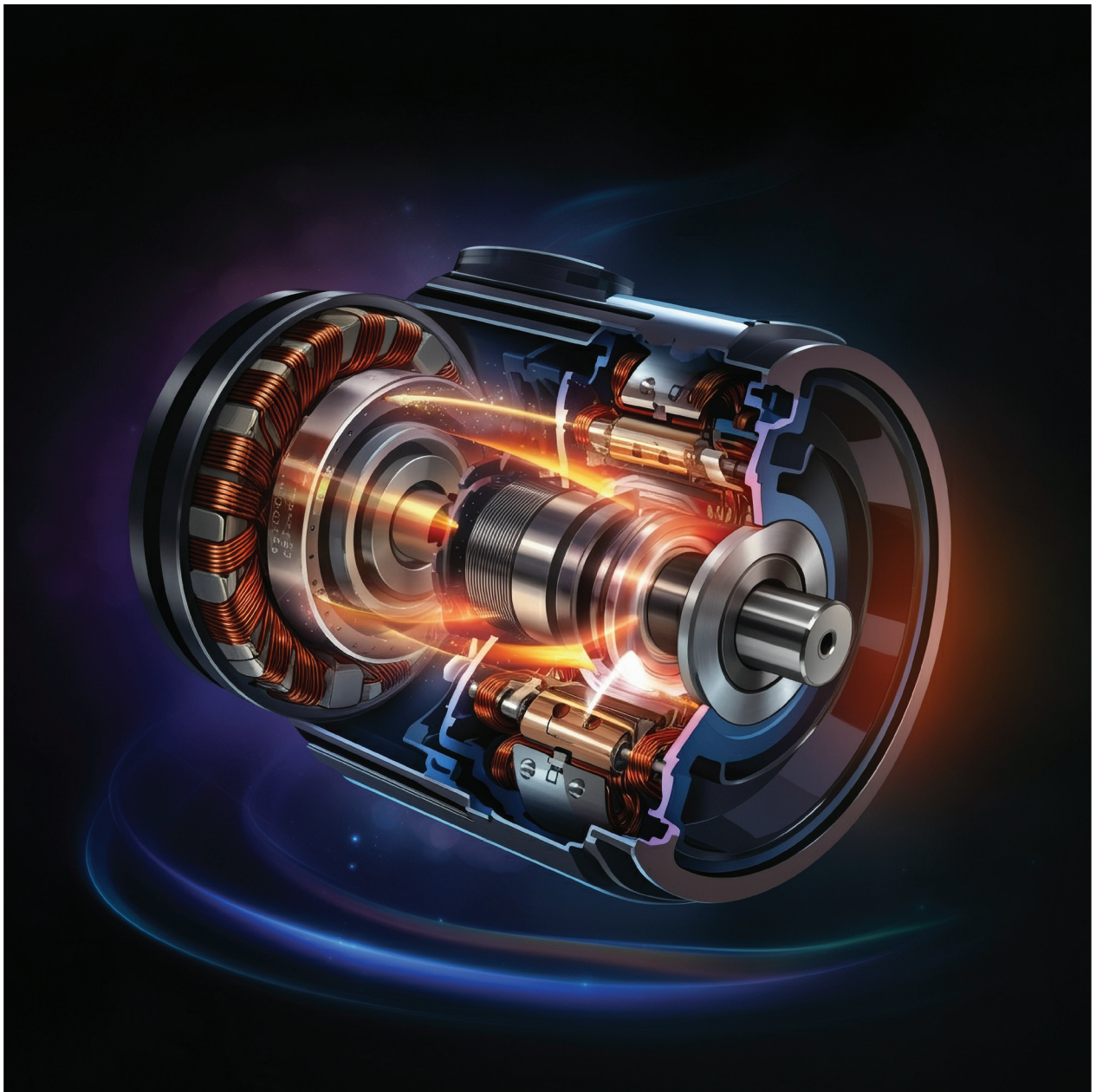*By the end of this laboratory course, learners will be able to:*

- Examine and understand the internal components of various motors (DC, Stepper, BLDC, PMSM, SRM) and learn about motor structures, operating principles, and performance characteristics.
- Develop practical skills in disassembling and assembling electric motors safely. Gain experience in using proper tools and techniques for motor maintenance.
- Understand the operation principles of three-phase DC-AC inverters and learn modulation techniques, such as Sinusoidal PWM (SPWM), for controlling inverter output.
- Measure speed, torque, and power output of motors using a tandem dynamometer and assess dynamic torque responses under varying load conditions and transient behaviors.
- Design and implement real-time control algorithms for BLDC, SRM, PMSM, and Induction motors using FPGA-based hardware-in-the-loop (HIL) testing.
- Analyze the performance of EV powertrains, including motors, controllers, and batteries under standard drive cycles.

INDUSTRY APPLICATIONS

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Skills gained in this lab are useful in:

- Motor selection, inverter control, and powertrain simulation for efficient EV design and performance optimization.
- Hands-on experience with motor disassembly/assembly and maintenance procedures, applicable in motor manufacturing, service, and repair sectors.
- Apply knowledge of inverters and motor control in energy conversion systems, such as wind turbines, solar power systems, and grid integration.
- Expertise in motor control and torque measurement for robotics applications, improving precision and performance in automated systems.
- Contribute to the development and optimization of electric propulsion systems for trains, buses, and other forms of electric transportation.
- Leverage motor control and real-time testing skills to enhance industrial automation, including conveyor systems, manufacturing equipment, and electric machines.