Electric Vehicle Technology and Manufacturing

Course Learning Objectives	• Understand the components and subsystems of electric vehicles (EVs). • Gain knowledge of electric vehicle assembly processes and manufacturing techniques. • Learn about testing and validation methods specific to electric vehicles. • Explore lean manufacturing principles and process optimization in the context of EV production. • Understand the maintenance and service requirements for electric vehicles. • Develop practical skills through laboratory sessions to reinforce theoretical knowledge. • Analyze and solve real-world industry-related problems related to electric vehicles.
Course Outcomes	• Implement the design and functioning of components and subsystems in electric vehicles. • Apply manufacturing techniques and assembly processes specific to electric vehicles. • Conduct testing and validation of electric vehicle systems and components. • Implement lean manufacturing principles and optimize processes in EV production. • Perform maintenance and service tasks for electric vehicles.
	• Analyze and solve real-world industry-related problems in the field of electric vehicles.

Course Duration: 45 Hours

Unit 1: Electric Vehicle Components and Subsystems

Introduction to electric vehicle architecture and components- Electric motor and drivetrain systems in EVs- Battery technologies and energy management systems- Charging systems and infrastructure for EVs

Unit 2: Electric Vehicle Assembly Processes

Overview of electric vehicle manufacturing processes- Body and chassis assembly techniques for EVs- Integration of electric power train components- Quality control and inspection in EV assembly

Unit 3: Electric Vehicle Testing and Validation

Test planning and procedures for electric vehicles- Performance testing and characterization of EV subsystems- Safety and reliability testing for EVs- Regulatory compliance and certification for electric vehicles

Unit 4: Lean Manufacturing and Process Optimization

Principles of lean manufacturing in the context of EV production- Value stream mapping and waste reduction techniques- Process optimization and continuous improvement in EV manufacturing- Ergonomics and workplace design considerations

Unit 5: Electric Vehicle Maintenance and Service

Electric vehicle maintenance requirements and best practices- Troubleshooting and diagnostics for EV systems- Safety considerations in EV maintenance and service- Customer service and EV user support

Test Projects:

20 Industry Use Cases:

1. Assembling electric motors and drivetrains for electric bicycles:

Task 1: Design and build a small-scale electric bicycle prototype using off-the- shelf components.

Task 2: Compare and evaluate different motor and drivetrain configurations for electric bicycles.

Task 3: Create a step-by-step guide on assembling an electric bicycle drivetrain system.

Task 4: Conduct performance tests to measure the speed and torque of various electric bicycle motors.

Task 5: Investigate the impact of different gear ratios on the efficiency and range of an electric bicycle.

2. Integrating battery packs and energy management systems in electric scooters:

Task 1: Design and build a battery pack for an electric scooter using rechargeable lithium-ion cells.

Task 2: Develop an energy management system to optimize battery usage and extend the range of an electric scooter.

Task 3: Evaluate the performance and efficiency of different battery chemistries for electric scooters.

Task 4: Implement a charging algorithm for the battery pack to maximize its lifespan.

Task 5: Conduct experiments to compare the range and acceleration of electric scooters with different battery configurations.

3. Testing the range and performance of electric golf carts:

Task 1: Design and conduct a range test for electric golf carts using different driving conditions and terrains.

Task 2: Measure and compare the power consumption of electric golf carts at different speeds.

Task 3: Analyze the impact of battery capacity and weight on the range and performance of electric golf carts.

Task 4: Investigate the effect of aerodynamics on the energy efficiency of electric golf carts.
Task 5: Develop a simulation model to predict the range of electric golf carts based on various factors.

4. Validating the safety and functionality of electric tricycles:

Task 1: Perform a safety inspection on electric tricycles to ensure compliance with relevant regulations and standards.
Task 2: Conduct a braking performance test to evaluate the stopping distance and stability of electric tricycles.
Task 3: Assess the visibility and effectiveness of lighting systems on electric tricycles.
Task 4: Analyze the stability and handling characteristics of electric tricycles through controlled maneuvers.
Task 5: Investigate the impact of different suspension setups on the comfort and safety of electric tricycles.

5. Implementing lean manufacturing principles to streamline the production of electric motorcycles:

Task 1: Conduct a value stream mapping analysis to identify waste and inefficiencies in the production process of electric motorcycles.
Task 2: Implement 5S workplace organization techniques to improve the cleanliness and organization of the assembly line.
Task 3: Optimize the layout of the production area to reduce material handling and increase workflow efficiency.
Task 4: Apply just-in-time (JIT) principles to minimize inventory and reduce production lead time for electric motorcycles.
Task 5: Implement visual management tools, such as Kanban boards, to improve communication and coordination between assembly line workers.

6. Optimizing the assembly process for electric skateboards.

Task 1: Design and implement a streamlined assembly line layout for electric skateboard production, considering ergonomic factors and efficient workflow.

Task 2: Develop a standardized checklist and quality control procedures to ensure the accurate installation of components during the skateboard assembly process.

Task 3: Evaluate and improve the efficiency of the battery installation process, exploring methods such as automation or specialized tools.

Task 4: Investigate different adhesive options for attaching grip tape to electric skateboard decks, focusing on ease of application and durability.

Task 5: Implement a lean manufacturing approach by identifying and eliminating waste in the assembly process, such as reducing unnecessary motion or inventory.

7. Conducting quality control inspections for electric off-road vehicles.

Task 1: Develop a comprehensive quality control checklist to ensure all components of the electric off-road vehicle are inspected thoroughly before delivery.

Task 2: Create a testing protocol to assess the performance and durability of critical off-road vehicle subsystems, such as the suspension or drivetrain.

Task 3: Implement a visual inspection process using imaging technology to identify any defects or inconsistencies in the vehicle's body or paintwork.

Task 4: Establish a data logging system to monitor and analyze key performance metrics of the off- road vehicle during quality control testing.

Task 5: Investigate and implement non-destructive testing methods, such as ultrasound or thermography, to detect any hidden defects or abnormalities in vehicle components.

8. Troubleshooting and diagnosing issues in electric-powered lawnmowers.

Task 1: Create a diagnostic flowchart or decision tree to guide technicians in identifying common electrical and mechanical issues in electric lawnmowers.

Task 2: Develop a step-by-step troubleshooting guide for diagnosing and resolving battery-related problems in electric lawnmower systems.

Task 3: Design and implement a test setup to assess the motor performance and control system functionality in electric lawnmowers.

Task 4: Investigate and document the most common failure modes in electric lawnmowers, along with recommended repair procedures for each issue.

Task 5: Collaborate with lawn mower manufacturers to analyze warranty claims data and identify recurring problems, leading to proactive measures for preventing those issues in future models.

9. Performing maintenance and service Task on electric-powered wheelchairs.

Task 1: Develop a comprehensive maintenance schedule for electric wheelchairs, outlining routine tasks such as battery inspection, tire replacement, and control system calibration.

Task 2: Design and implement a battery management system that monitors and optimizes the charging and discharging cycles of electric wheelchair batteries to extend their lifespan.

Task 3: Create a user-friendly troubleshooting guide for common issues faced by wheelchair users, providing step-by-step instructions for identifying and resolving problems.

Task 4: Develop a training program for wheelchair users and caregivers, covering basic maintenance Task such as cleaning, lubrication, andadjusting seating positions.

Task 5: Investigate and recommend ergonomic enhancements to improve user comfort and reduce the risk of musculoskeletal disorders associated with operating electric wheelchairs.

10. Testing the charging infrastructure for electric buses at a transit depot.

Task 1: Conduct a comprehensive site survey to assess the electrical capacityand compatibility of the transit depot for accommodating the charging infrastructure required for electric buses.

Task 2: Develop a testing protocol to evaluate the reliability and performance of charging stations, including factors such as charging speed, efficiency, and interoperability with different bus models.

Task 3: Create a monitoring system to collect and analyze charging data, allowing for the identification of any inefficiencies or anomalies in the charging process.

Task 4: Investigate the feasibility of implementing smart charging solutions, such as demand response systems or vehicle-to-grid integration, to optimize the energy usage and minimize the peak load on the electrical grid.

Task 5: Collaborate with bus manufacturers and charging equipment suppliers to ensure compatibility and optimize the integration between the electric buses and the charging infrastructure at the transit depot.

11. Validating the performance and efficiency of electric delivery trucks:

Task 1: Analyze the energy consumption of different delivery routes and propose optimization strategies.

Task 2: Develop a data logging system to measure and compare the performance of electric delivery trucks under various load conditions.

Task 3: Conduct a comparative study on the range and efficiency of different electric delivery truck models available in the market.

Task 4: Design and implement a simulation model to assess the impact of driving behavior on the energy consumption of electric delivery trucks.

Task 5: Create a performance benchmarking tool to evaluate the acceleration, braking, and overall efficiency of electric delivery trucks.

12. Optimizing the manufacturing process for electric-powered drones:

Task 1: Investigate different assembly line layouts and identify the most efficient configuration for drone production.

Task 2: Develop a quality control system to monitor the manufacturing process and identify areas for improvement.

Task 3: Implement lean manufacturing techniques, such as Kanban systems or value stream mapping, to optimize the production flow of electric drones.
Task 4: Study the feasibility of automation and robotics in drone manufacturing and propose ways to streamline the process.
Task 5: Conduct a cost analysis to identify potential cost-saving measures inthe manufacturing of electric-powered drones.

13. Conducting safety inspections on electric-powered forklifts:

Task 1: Develop a comprehensive checklist for inspecting electric forklifts, covering critical safety components and systems.
Task 2: Create a training program for forklift operators on pre-operation safety checks and preventive maintenance procedures.
Task 3: Conduct a risk assessment to identify potential safety hazards associated with electric forklift operation and suggest mitigation strategies.
Task 4: Investigate the effectiveness of different safety technologies, such as proximity sensors or backup cameras, in preventing accidents involving electric forklifts.
Task 5: Design a data collection system to monitor and analyze safety incidents related to electric forklifts, aiming to identify trends and implement corrective measures.

14. Troubleshooting and repairing electric-powered recreational vehicles (RVs):

Task 1: Develop a diagnostic tool or checklist to identify common electrical issues in electric RVs.
Task 2: Create a maintenance schedule for electric RVs, including battery health checks, motor inspections, and electrical system maintenance.
Task 3: Conduct a study on the most common causes of electric RV failures and propose preventive measures.
Task 4: Investigate the compatibility and performance of different charging stations for electric RVs and provide recommendations.
Task 5: Develop a guide for troubleshooting and repairing specific electric components in RVs, such as inverters, solar panels, or electric heating systems.

15. Testing the reliability and durability of electric-powered boats:

Task 1: Design and implement a series of stress tests to evaluate the performance and durability of electric boat batteries under different operating conditions.

Task 2: Conduct a comparative study on the reliability of electric propulsion systems versus traditional combustion engines for boats.

Task 3: Develop a water-resistant sealing system for electric boat components to ensure their reliability in harsh marine environments.

Task 4: Create a testing protocol to assess the impact of charging cycles on the longevity of electric boat batteries.

Task 5: Investigate the effects of different environmental factors, such as water salinity or temperature, on the performance and reliability of electric-powered boats.

16. Conducting maintenance and service on electric-powered jet skis:

Task 1: Developing a maintenance checklist for electric-powered jet skis, including Task such as battery inspection, electrical system diagnostics, and motor lubrication.

Task 2: Designing a preventive maintenance schedule for electric-powered jet skis, outlining

recommended intervals for battery charging, component inspections, and software updates.

Task 3: Creating a troubleshooting guide for common issues in electric- powered

jet skis, including step-by-step procedures for diagnosing and resolving electrical or mechanical problems.

Task 4: Developing a battery management system for electric-powered jet skis, focusing on monitoring battery health, optimizing charging cycles, and implementing safety measures.

Task 5: Conducting a comparative study on different maintenance techniques for electric-powered jet skis, evaluating the effectiveness of regular maintenance versus reactive repairs.

17. Validating the charging efficiency of electric-powered streetlights:

Task 1: Designing an experimental setup to measure and compare the charging efficiency of different electric-powered street lights using various charging technologies.

Task 2: Analyzing the energy consumption patterns of electric-powered street lights in different scenarios, such as peak and off-peak hours, and identifying areas for optimization.

Task 3: Investigating the impact of environmental factors, such as temperature and humidity, on the charging efficiency of electric- powered street lights and proposing solutions to mitigate any performance issues.

Task 4: Developing a monitoring system to track the charging efficiency and overall energy consumption of electric-powered street lights, providing real-time data for analysis and optimization.

Task 5: Conducting a field study to validate the charging efficiency of electric-powered street lights in a real-world setting, comparing the results with theoretical calculations and industry standards.

18. Optimizing the assembly process for electric-powered rickshaws:

Task 1: Analyzing the existing assembly process for electric-powered rickshaws and identifying areas of inefficiency or bottlenecks.

Task 2: Implementing lean manufacturing principles, such as value stream mapping and waste reduction techniques, to streamline the assembly process and improve overall productivity.

Task 3: Designing ergonomic workstations and tools specifically tailored for the assembly of electric-powered rickshaws, considering factors such as worker comfort and safety.

Task 4: Developing standardized work instructions and training materials to ensure consistency and quality throughout the assembly process of electric- powered rickshaws.

Task 5: Conducting time-motion studies to optimize the sequencing of assembly tasks and identify opportunities for automation of process simplification in the assembly of electric-powered rickshaws.

19. Conducting performance tests on electric-powered go-karts:

Task 1: Designing a performance testing track or course specifically for electric-powered go-karts, considering factors such as speed, acceleration, and handling characteristics.

Task 2: Collecting data through instrumentation and sensors to measure and analyze the performance metrics of electric-powered go-karts, including lap times, power output, and energy consumption.

Task 3: Comparing the performance of different electric-powered go-karts by conducting controlled experiments and benchmarking tests.

Task 4: Investigating the effects of variables such as battery capacity, motor power, and weight distribution on the performance of electric-powered go-karts, and optimizing these factors for improved performance.

Task 5: Conducting durability tests on electric-powered go-kart components, such as batteries, motors, and chassis, to assess their reliability and identify any performance limitations.

20. Troubleshooting and diagnosing issues in electric-powered food trucks:

Task 1: Developing a comprehensive troubleshooting guide for common electrical and mechanical issues in electric-powered food trucks, providing step- by-step procedures for diagnosing and resolving problems.

Task 2: Designing a diagnostic tool or system that can quickly identify and report potential issues in the electrical system, battery, or other components of electric-powered food trucks.

Task 3: Conducting a thorough inspection and maintenance program for electric-powered food trucks, including regular checks of critical components, wiring integrity, and electrical connections.

Task 4: Analyzing real-world case studies of electrical failures or malfunctions in electric-powered food trucks, identifying root causes and proposing preventive measures or design improvements.

Task 5: Developing a training program for food truck operators and technicians, focusing on troubleshooting techniques, preventive maintenance, and safe handling of electrical components in electric-powered food trucks.

Student Assessment Plan:

Each of the above-mentioned test projects will be divided into tasks by the training partner for each specific institution. Such tasks will be jointly evaluated by the faculty and the training partner and the following weightage is to be followed.

- 70% weightage to the external practical assessment.
- 30% weightage to the internal assessment.

Final Test Project/External Assessment Plan:

The Final Test Project will be chosen from the list given above, jointly by the college faculty and the Training Partner. The Final Test Project will be assessed on the following tasks, for 70%

Details	**Marks**
Task: 1	20
Task: 2	20
Task: 3	20
Task: 4	20
Task: 5	20

Employment Potential:

This course shall enable mechanical, automobile and allied domain Engineers to get employment in sectors automobile, manufacturing and etc.