COURSE NAME:	Sustainability & Green Chemistry in EV Sector
TOTAL DURATION:	45 Hrs
MODE OF DELIVERY	PHYSICAL CLASSROOM TRAINING
TRAINER TO STUDENT RATIO:	1:50
TOTAL MARKS:	75

Table 1	
OVERALL COURSE OBJECTIVE:	1. Assess the challenges and opportunities in adopting sustainability principles within the EV sector, prioritizing environmental and economic benefits. 2. Develop and implement strategies to incorporate green chemistry principles in EV manufacturing processes, minimizing environmental impact. 3. Conduct lifecycle assessments to evaluate resource efficiency and propose actionable improvements for reducing carbon footprint in EV production. 4. Design AI-driven solutions to enhance green chemistry practices, streamline processes, and ensure real-time monitoring and reporting. 5. Formulate strategies to ensure compliance with global and regional sustainability frameworks, promoting scalable and ethical EV production practices.

LEARNING OUTCOME:	1. Evaluate sustainability challenges in the EV sector and design eco-friendly manufacturing strategies using green chemistry principles. 2. Conduct and interpret lifecycle assessments to identify inefficiencies, reduce carbon footprints, and improve resource utilization in EV production.

	3. Create predictive AI tools to monitor green chemistry practices, automate sustainability reporting, and enhance decision-making in real-time. 4. Align EV manufacturing practices with global sustainability standards, demonstrating expertise in preparing documentation and conducting mock audits. 5. Design forward-thinking solutions by integrating future trends and technologies in green chemistry, ensuring scalability and sustainability in the EV sector.

TABLE 2: MODULE WISE COURSE CONTENT AND OUTCOME

SL. NO	MODULE NAME	MODULE CONTENT	MODULE LEARNING OUTCOME	DURATION (HRS)
1	Sustainability and Green Chemistry in EVs	- Overview of sustainability challenges in the EV sector - Fundamentals of green chemistry and its application to EV production - Eco-friendly materials in EV manufacturing - Lifecycle assessments to measure environmental impact	Prioritize sustainability in EV manufacturing by integrating green chemistry principles, selecting eco-friendly materials, and performing lifecycle assessments to optimize resource utilization and minimize environmental impact.	9

2	Advanced Tools for Green Chemistry Optimization	- Application of AI tools in monitoring and enhancing green chemistry - Development of predictive models for sustainability optimization - Automation of sustainability reporting using AI-driven tools	Create AI-driven solutions to optimize green chemistry practices, including predictive modeling, real-time monitoring, and automated reporting, to enhance the sustainability of EV production processes.	9
3	Regulatory Frameworks and Compliance	- Alignment with global sustainability standards (e.g., ISO 14001, GRI guidelines) - Documentation for regulatory compliance - Mock audits for sustainability frameworks	Evaluate and ensure compliance with global sustainability standards, prepare documentation for audits, and align EV manufacturing practices with regulatory frameworks to promote eco-friendly production processes.	9
4	Real-World Applications and Workshops	- Case studies on sustainable EV production - Hands-on workshops for implementing green chemistry solutions - Evaluation and improvement of green practices through practical exercises	Develop practical solutions by examining real-world case studies, conducting hands-on workshops, and proposing improvements to current green chemistry practices in EV manufacturing based on workshop outcomes.	9

5	Innovations and Future Trends in Green Chemistry	- Emerging technologies in green chemistry for EVs - Innovations in sustainable EV production - Strategies to integrate future trends in green chemistry and sustainability practices	Formulate strategies to adopt emerging technologies and innovations in green chemistry, preparing for the future of sustainable EV production by identifying impactful advancements and integrating them into existing processes.	9

TABLE 3: OVERALL COURSE LEARNING OUTCOME ASSESSMENT CRITERIA AND USE CASES

LEARNING OUTCOME	**ASSESSMENT CRITERIA**	**Performance Criteria**	**USE CASES**
Prioritize sustainability in EV manufacturing by integrating green chemistry principles and eco-friendly materials.	Evaluate sustainable practices and material choices.	Recommend eco-friendly materials and justify their benefits for EV manufacturing. Design production processes that reduce carbon footprint and waste.	Create a report proposing sustainable materials for EV battery production, highlighting environmental benefits and cost-effectiveness.
Perform lifecycle assessments to optimize resource utilization and reduce environmental	Conduct lifecycle assessments (LCAs) for key EV components.	Measure and report carbon footprint across production stages. Propose actionable recommendations to	Perform an LCA for EV battery production, identifying stages with high emissions and

impact in EV production.		improve resource efficiency and reduce emissions.	suggesting strategies to reduce environmental impact.
Develop AI-driven solutions to monitor and enhance green chemistry practices in EV manufacturing.	Utilize AI tools and predictive models for sustainability optimization.	Automate sustainability reporting with AI-driven tools. Use predictive analytics to optimize green chemistry processes in real-time.	Implement an AI model to monitor energy efficiency in EV production and generate automated reports on sustainability metrics.
Align EV sector practices with global sustainability standards and frameworks.	Assess compliance with sustainability regulations and standards.	Prepare documentation for audits and demonstrate adherence to sustainability frameworks like ISO 14001 or GRI. Conduct mock audits to ensure process compliance.	Conduct a mock audit for an EV production unit to evaluate its alignment with ISO 14001 standards, proposing corrective actions where necessary.
Formulate strategies to integrate innovations and future trends in green chemistry	Identify and evaluate emerging technologies in green chemistry.	Design processes incorporating new green technologies. Present a plan to implement innovative solutions for enhancing	Develop a roadmap for integrating hydrogen-based battery production technology, considering its scalability and

for EV manufacturing.		sustainability in EV production.	environmental impact.

TABLE 4: LIST OF FINAL PROJECTS (PROJECTS THAT COMPREHENSIVELY COVER ALL THE LEARNING OUTCOME)	
SL.NO	**FINAL PROJECT**
1	AI-powered tool for minimizing waste in EV manufacturing.
2	Lifecycle analysis for a specific EV component.
3	Design a sustainable EV battery production model.
4	Case study on reducing hazardous waste in EV production.
5	Green chemistry audit for an EV manufacturing plant.
6	Develop a waste management protocol using green chemistry.
7	AI-based analysis for material substitution in EV batteries.
8	Propose sustainable alternatives for EV interior materials.
9	Cost-benefit analysis of green materials in EV.
10	Create a dashboard for tracking green practices in production.
11	Study of eco-friendly production techniques.
12	Predictive analysis of EV production impact using AI.
13	Design a green chemistry curriculum for industry training.
14	Sustainable resource management in EV supply chain.
15	Document on global regulations for green chemistry in EV.

16	AI model for sustainable material sourcing.
17	Proposal for biodegradable packaging for EV parts.
18	Study on the life cycle of lithium-ion batteries.
19	Framework for energy-efficient EV production.
20	Impact assessment of green chemistry in EV sectors globally.

TABLE 5: COURSE ASSESSMENT RUBRICS (TOTAL MARKS: 75)					
ASSESSMENT CRITERIA	**Learning Outcome**	**Fair (1–5)**	**Good (6–10)**	**Excellent (11–15)**	**TOTAL MARKS**
Evaluating Sustainable Practices and Material Choices	Prioritize sustainability in EV manufacturing by integrating green chemistry principles and eco-friendly materials.	Proposes basic eco-friendly materials with limited impact on sustainability.	Recommends effective materials and provides detailed comparisons of environmental benefits.	Designs innovative processes that integrate advanced green materials and maximize environmental benefits.	15
Conducting Lifecycle Assessments (LCAs)	Perform lifecycle assessments to optimize resource utilization and reduce environmental impact in	Identifies basic lifecycle stages but provides limited recommendations.	Measures key resource metrics and suggests moderate improvements for resource efficiency.	Delivers comprehensive lifecycle analyses with innovative strategies to minimize	15

	EV production.			emissions and waste.	
Utilizing AI Tools for Green Chemistry Optimization	Develop AI-driven solutions to monitor and enhance green chemistry practices in EV manufacturing.	Demonstrates limited application of AI tools and basic automation capabilities.	Effectively uses AI tools for real-time monitoring and moderate optimization of green practices.	Creates advanced AI-driven models to fully optimize processes, automate reporting, and enhance efficiency.	15
Compliance with Sustainability Standards	Align EV sector practices with global sustainability standards and frameworks.	Demonstrates basic understanding of standards and partial compliance documentation.	Prepares accurate compliance reports and demonstrates strong alignment with sustainability goals.	Conducts detailed mock audits and presents innovative solutions to exceed sustainability requirements.	15
Integrating Innovations in Green Chemistry	Formulate strategies to integrate innovations and future trends in green chemistry for EV manufacturing.	Identifies emerging trends but lacks detailed integration strategies.	Develops practical strategies to incorporate innovations in green chemistry.	Proposes innovative, future-ready strategies that significantly enhance sustainability and scalability.	15