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| **COURSE NAME:** | Chemical Safety in Battery Management |
| **TOTAL DURATION:** | 45 Hrs |
| **MODE OF DELIVERY** | PHYSICAL CLASSROOM TRAINING AT RESPECTIVE COLLEGES |
| **TRAINER TO STUDENT RATIO:** | 1:50 |
| **TOTAL MARKS:** | 75 |

| **Table 1** | |
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| **OVERALL COURSE OBJECTIVE:** | 1. Evaluate hazardous materials, identify risks in battery production, and ensure proper handling of chemicals in compliance with industry standards.<br>2. Design and implement mitigation strategies for chemical exposure, ensuring safety and reducing workplace hazards.<br>3. Apply AI technologies for advanced chemical safety monitoring, risk prediction, and compliance management.<br>4. Formulate emergency response plans and train personnel for effective incident management in battery production scenarios.<br>5. Formulate emergency response plans and train personnel for effective incident management in battery production scenarios. |

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| **LEARNING OUTCOME:** | 1. Categorize chemicals based on hazard levels, interpret Safety Data Sheets (SDS), and evaluate their potential risks in industrial applications.<br>2. Conduct comprehensive risk assessments, recommend and justify effective safety measures, and evaluate their implementation in chemical handling.<br>3. Develop and apply AI models for real-time monitoring of chemical safety, predicting spill risks, and enhancing compliance protocols.<br>4. Formulate and simulate effective chemical spill response strategies, ensuring regulatory compliance and operational readiness.<br>5. Propose innovative recycling strategies and sustainable alternatives for hazardous chemicals in alignment with |

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| | environmental standards. |

| TABLE 2: MODULE WISE COURSE CONTENT AND OUTCOME | | | | |
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| **SL.NO** | **MODULE NAME** | **MODULE CONTENT** | **MODULE LEARNING OUTCOME** | **DURATION (HRS)** |
| 1 | Chemical Safety Fundamentals | Analyze chemical safety basics, hazardous material classifications, safety data sheets (SDS), and risk assessment principles. | Categorize hazardous materials and evaluate their associated risks in battery production processes. | 8 |
| 2 | Risk Management and Regulations | Evaluate risks in chemical handling, mitigation strategies, exposure limits, and compliance with OSHA, REACH, and GHS regulations. | Assess risk factors, justify mitigation strategies, and defend compliance practices during safety audits and inspections. | 9 |
| 3 | Chemical Storage and Emergency Protocols | Analyze best practices for chemical storage, transportation, and emergency response, including incident management and safety drills. | Examine storage and transportation protocols, develop emergency response plans, and evaluate their effectiveness in managing chemical incidents. | 10 |
| 4 | AI and Advanced Safety | Explore AI-based safety tools for real-time | Utilize AI tools to analyze safety data, | 9 |

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| | Monitoring | monitoring, predictive analytics, and risk prevention in chemical safety management. | propose improvements to risk prevention mechanisms, and evaluate predictive safety strategies. | |
| 5 | Sustainability and Practical Applications | Investigate sustainable practices in chemical disposal, recycling, and alternatives, alongside case studies and hands-on workshops. | Design sustainable solutions for chemical usage, apply theoretical knowledge to case studies, and create innovative approaches to promote sustainability. | 9 |

| **TABLE 3: OVERALL COURSE LEARNING OUTCOME ASSESSMENT CRITERIA AND USE CASES** | | | |
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| **LEARNING OUTCOME** | **ASSESSMENT CRITERIA** | **Performance Criteria** | **USE CASES** |
| Analyze and classify hazardous chemicals and safety data. | Develop a classification guide and analyze SDS documents. | Accurately categorize hazardous chemicals and extract key safety instructions. | - Develop a classification guide for hazardous chemicals used in battery production. |

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| Conduct risk assessments and evaluate chemical handling risks. | Conduct risk assessments and analyze chemical exposure scenarios. | Identify potential hazards, prioritize risks, and recommend mitigation measures. | - Conduct a risk assessment for chemical exposure in a battery production facility. |
| Design and execute safety protocols for chemical incidents. | Simulate emergency scenarios and develop response plans. | Execute well-coordinated, effective emergency protocols during simulated incidents. | - Simulate a chemical spill scenario and execute an emergency response protocol. |
| Utilize AI tools for predictive safety and compliance management. | Develop AI-based predictive models and compliance documentation. | Create accurate risk prediction models and prepare comprehensive regulatory documentation. | - Develop a predictive model for chemical spill risks using AI tools. |
| Promote sustainability and training in chemical safety practices. | Propose sustainable alternatives and design training programs. | Create actionable, innovative solutions and engaging safety training modules. | - Design a training module for factory workers on chemical safety best practices. |

**TABLE 4: LIST OF FINAL PROJECTS (PROJECTS THAT COMPREHENSIVELY COVER ALL THE LEARNING OUTCOME)**

| SL.NO | FINAL PROJECT |
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| 1 | Hazardous Chemical Classification: Create a comprehensive database for classifying hazardous chemicals used in battery manufacturing. |
| 2 | Safety Data Sheet (SDS) Analysis Tool: Develop a tool to extract and summarize critical safety instructions from SDS documents. |

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| 3 | Chemical Risk Assessment Framework: Design a system to evaluate and mitigate chemical exposure risks in production facilities. |
| 4 | AI-Driven Spill Risk Prediction: Build a predictive analytics model using AI to foresee chemical spill risks and suggest preventive measures. |
| 5 | Regulatory Compliance Management: Develop a workflow to generate and validate compliance documentation for OSHA and GHS audits. |
| 6 | Emergency Response Protocol Simulation: Create a virtual or physical simulation to train workers on responding to chemical spills. |
| 7 | Training Module for Workers: Design an interactive training program on chemical safety best practices tailored for battery production staff. |
| 8 | Sustainable Chemical Substitution: Propose viable, environmentally friendly alternatives for hazardous chemicals used in battery production. |
| 9 | Chemical Recycling Strategy: Develop a recycling plan to handle and repurpose used chemicals from battery manufacturing processes. |
| 10 | Mock Safety Audit Framework: Create a detailed process for conducting internal safety audits to identify compliance gaps and improve safety standards. |

| **TABLE 5: COURSE ASSESSMENT RUBRICS (TOTAL MARKS: 75)** | | | | | |
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| **ASSESSMENT CRITERIA** | **Learning Outcome** | **Fair (1–5)** | **Good (6–10)** | **Excellent (11–15)** | **TOTAL MARKS** |
| Classification of Hazardous Chemicals | Analyze and categorize hazardous chemicals | Identifies basic chemical categories with limited | Differentiates hazardous chemicals effectively | Accurately categorizes hazardous chemicals and outlines | 15 |

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| | used in battery production. | accuracy. | with minimal errors. | their specific risks and applications comprehensively. | |
| Risk Assessment and Mitigation | Conduct risk assessments and recommend mitigation measures for chemical exposure in battery facilities. | Conducts a basic assessment with minimal or no mitigation strategies. | Analyzes risks effectively and proposes some feasible mitigation strategies. | Critically evaluates chemical risks and develops comprehensive, actionable mitigation plans. | 15 |
| AI for Safety Monitoring | Develop predictive models for chemical spill risks using AI-based tools. | Designs a basic model with limited functionality or accuracy. | Constructs a functional model with moderate predictive accuracy and relevance. | Innovates and develops a highly accurate and relevant AI-driven spill prediction model. | 15 |
| Emergency Response and Compliance | Simulate a spill scenario and prepare compliance documentation for audits. | Prepares a partial or incomplete response protocol and documentation. | Simulates a complete response protocol with minor gaps in execution or compliance | Executes a flawless spill response and prepares comprehensive, audit-ready compliance | 15 |

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| | | | documentation. | documentation. | |
| Sustainability and Recycling | Propose sustainable alternatives and recycling strategies for hazardous chemicals used in production | Recommends alternatives or strategies with limited feasibility or impact. | Proposes feasible and moderately impactful sustainable alternatives or recycling plans. | Innovates highly effective and sustainable chemical alternatives and recycling strategies with measurable benefits. | 15 |