

Annexure I: Course Curriculum

TABLE 1: MODULE-WISE COURSE CONTENT AND OUTCOME				
SL.NO	MODULE NAME	MODULE CONTENT	MODULE LEARNING OUTCOME	DURATION (HRS)
1	Introduction to Data in Process Industries	Understanding types of data (operational, sensor, historical) and their relevance.	Gain foundational knowledge of data usage and its impact on decision-making and efficiency in industries like manufacturing.	4
2	Data Collection and Preprocessing	Data collection from industrial sources (IoT, SCADA), data cleaning, handling missing values, and transformations.	Learn to collect, clean, and preprocess data for analytics, ensuring data quality and reliability	5
3	Predictive Maintenance Models	Using historical and real-time data to build predictive models for equipment failure.	Build and evaluate predictive models for machinery failure, optimizing maintenance schedules.	5
4	Process Optimization Techniques	Applying optimization techniques (Linear Programming, Genetic Algorithms) to improve yield and efficiency while reducing waste.	Optimize industrial processes to enhance production and reduce costs.	5
5	Real-Time Data	Setting up real-	Implement real-	4

	Analytics for Process Control	time data pipelines, developing control systems, and monitoring for process deviations.	time systems to monitor, analyze, and control industrial processes dynamically.	
6	Statistical Process Control (SPC)	Designing SPC charts, detecting out-of-control conditions, and improving process stability and quality.	Monitor and control process performance using SPC techniques.	4
7	Machine Learning for Process Optimization	Applying supervised (e.g., regression, classification) and unsupervised (e.g., clustering, anomaly detection) learning algorithms to process data.	Solve real-world optimization problems using machine learning techniques.	5
8	Data Visualization for Industrial Insights	Creating dashboards and reports using tools like Tableau and Power BI, and presenting actionable insights to decision-makers.	Develop visualizations and interactive dashboards to aid in decision-making for stakeholders.	4
9	Time Series Modeling and Forecasting	Building time series models (ARIMA, Exponential Smoothing, Prophet) for production demand	Predict future production needs and optimize supply chain and resource management.	5

		forecasting and resource allocation.		
10	Capstone Project: Industrial Data Analytics Implementation	Integrating predictive maintenance, optimization, and real-time monitoring into a comprehensive solution and presenting to stakeholders.	Apply learned skills in a real-world scenario, presenting actionable insights and solutions to industry challenges.	4

Annexure II: Use cases and Test Projects

TABLE 2: OVERALL COURSE LEARNING OUTCOME ASSESSMENT CRITERIA AND USECASES			
LEARNING OUTCOME	ASSESSMENT CRITERIA	PERFORMANCE CRITERIA	USECASES
Understand predictive maintenance techniques and build ML models to predict equipment failures.	Ability to preprocess historical and real-time data, select suitable algorithms, and evaluate model performance.	Identify key features from sensor data, build ML models like Random Forest or SVM, and validate accuracy to predict maintenance needs.	Predicting failures in manufacturing equipment to reduce downtime and optimize maintenance costs.
Learn to apply optimization algorithms for energy efficiency and cost reduction.	Ability to analyze energy usage data and apply techniques like Linear Programming or Genetic Algorithms.	Build energy usage models, optimize consumption patterns, and assess impact on cost and operational efficiency.	Reducing energy consumption in chemical plants while maintaining output.
Develop real-time monitoring systems to ensure product quality.	Proficiency in setting up real-time data pipelines and integrating quality metrics for process control.	Use IoT and SCADA systems to collect data, implement real-time anomaly detection models, and maintain consistent quality standards.	Ensuring product quality in food processing with real-time data monitoring.
Understand process control systems and implement real-time adjustments using analytics.	Ability to configure real-time control mechanisms and evaluate their impact on process variables.	Monitor critical parameters like temperature and pressure, adjust process conditions dynamically, and optimize operational efficiency.	Ensuring stability and efficiency in oil refining processes.

Forecast demand and optimize supply chain logistics.	Evaluate demand patterns using forecasting models like ARIMA or Prophet and optimize inventory levels.	Build demand forecasting models, integrate supply chain optimization tools, and validate predictions with historical data.	Improving supply chain efficiency and reducing overstock/shortages in beverage manufacturing.
Learn to identify inefficiencies in production processes and minimize waste.	Proficiency in analyzing production data and applying process optimization techniques.	Use data analytics to identify sources of waste, implement waste-reduction strategies, and measure performance improvements.	Minimizing material wastage and reducing production costs in textile factories.
Apply data analytics to optimize resource usage and reduce waste.	Analyze water usage data, identify patterns, and apply optimization algorithms for resource allocation.	Monitor water consumption, optimize usage for cleaning/processing, and ensure compliance with sustainability goals.	Reducing water consumption in dairy processing plants.
Build automated systems for maintaining optimal production temperatures.	Configure temperature monitoring systems and develop models for real-time adjustments.	Set up sensors to monitor temperature, build anomaly detection models, and implement dynamic control systems.	Maintaining temperature standards in pharmaceutical manufacturing to ensure product quality.
Develop anomaly detection models to ensure equipment reliability.	Ability to preprocess sensor data and apply machine learning models for anomaly detection.	Build and test models like Isolation Forest or Autoencoders to identify anomalies in sensor data.	Identifying and addressing equipment issues in industrial assembly lines.

Analyze downtime patterns to optimize production schedules.	Identify root causes of downtime using data visualization and statistical methods.	Use tools like Power BI to visualize downtime data, identify trends, and suggest actionable insights.	Reducing production downtime in manufacturing.
Implement real-time monitoring for HVAC systems to ensure efficiency.	Ability to set up IoT devices, collect real-time data, and analyze for operational optimization.	Develop real-time data pipelines, analyze HVAC efficiency metrics, and implement control systems for energy savings.	Optimizing HVAC performance in industrial buildings.
Learn to apply analytics for inventory optimization and cost savings.	Analyze stock data, forecast inventory needs, and minimize holding costs.	Build inventory management models, integrate them with operational data, and validate their efficiency.	Streamlining inventory processes in chemical warehouses.
Optimize batch production schedules and processes using analytics.	Improving efficiency in pharmaceutical batch processing.	Improving efficiency in pharmaceutical batch processing.	Improving efficiency in pharmaceutical batch processing.
Learn to optimize asset usage and extend equipment lifecycle through analytics.	Analyze maintenance and usage data, applying lifecycle management frameworks.	Build models to predict optimal replacement times and integrate findings into asset management systems.	Maximizing equipment lifespan and minimizing downtime costs.
Predict future energy needs using historical data and optimize usage.	Ability to build forecasting models and validate them against historical consumption	Apply models like ARIMA to forecast energy demand and use findings to optimize operational costs.	Reducing energy consumption and costs in cement production.

	patterns.		
Balance production demand with supply chain constraints through optimization.	Analyze demand and supply data and apply optimization techniques to improve balance.	Use optimization models to plan production schedules and inventory levels efficiently.	Minimizing costs while meeting production targets.

TABLE 3: LIST OF FINAL PROJECTS (20 PROJECTS THAT COMPREHENSIVELY COVER ALL THE LEARNING OUTCOME)	
SL.NO	FINAL PROJECT
1	Predictive Maintenance for Manufacturing Equipment
2	Energy Optimization in a Chemical Plant
3	Real-Time Quality Control in a Food Processing Unit
4	Process Control in an Oil Refinery
5	Supply Chain Forecasting for a Beverage Manufacturing Plan
6	Waste Reduction in a Textile Factory
7	Optimization of Water Usage in a Dairy Processing Plant
8	Temperature Control System in a Pharmaceutical Manufacturing Unit
9	Sensor Data Anomaly Detection in an Industrial Assembly Line
10	Production Downtime Analysis in a Manufacturing Facility

11	Real-Time Monitoring System for HVAC Systems in Industrial Buildings
12	Inventory Management Optimization in a Chemical Warehouse
13	Batch Process Optimization in a Pharmaceutical Factory
14	Asset Lifecycle Management for Industrial Equipment
15	Energy Consumption Forecasting in a Cement Factory
16	Demand-Supply Optimization in a Manufacturing Unit
17	Real-Time Process Visualization for a Steel Plant
18	Sensor Data Integration for Automated Control in a Mining Operation
19	Predictive Analytics for Stock Price Movements in an Oil & Gas Company
20	Automated Anomaly Detection in Water Treatment Plant Operations

Annexure III: Assessment Rubrics

TABLE 4: COURSE ASSESSMENT RUBRICS (TOTAL MARKS: 70)				
ASSESSMENT CRITERIA	DESCRIBE THE CRITERIA OF THE BELOW CATEGORY PERFORMANCE			TOTAL MARKS
	FAIR	GOOD	EXCELLENT	
MCQ/Programming/Project Submission Round	Above 40	Above 55	Above 65	70

Category	Assessment Criteria	Performance Levels	Weightage (Marks)
Practical Skills Proficiency	Demonstrates ability to perform job-specific tasks effectively, using relevant tools, techniques, or methodologies (e.g., Tally for accounting, consignment tracking).	Fair, Good, Excellent	20
Technical Knowledge Application	Applies theoretical concepts to practical scenarios with accuracy and relevance (e.g., compliance with GST laws, financial planning, or logistics protocols).	Fair, Good, Excellent	15

Project Execution	Completes assigned projects or use cases demonstrating innovation, thoroughness, and skill application relevant to industry standards.	Fair, Good, Excellent	25
Communication and Reporting	Clearly presents findings, solutions, or project outcomes using professional communication and documentation standards (e.g., reports, presentations).	Fair, Good, Excellent	10