COURSE DETAILS

Course Code:1101

Course Title: Gear Engineering

Brief Overview:
Gears are used in a wide range of industries, including automobiles, machine tools, aerospace, and general engineering, among others. As the demand for higher-quality gears increases, manufacturers are actively seeking advanced machine tools and technologies to meet these needs. Customer expectations are primarily influenced by the desire for improved performance, lower costs, lighter weight, better efficiency, and reduced noise. To satisfy the growing demand for higher productivity and gear quality, it is crucial to have a solid understanding of the various gear manufacturing processes and the key parameters that control them.

Focused Areas:
- Overview of various types of gears, gear design principles, standards, classification, and applications.
- Gear design, including the design of spur and helical gears, gear correction techniques, and case studies
- Understanding gear inspection methods.
- Selection of materials and heat treatment methods.
- Exploration of gear manufacturing processes, machinery, quality assurance, general maintenance, and troubleshooting techniques

Key Takeaways:
- Gaining an overview of the complete gear manufacturing process, from start to finish.
- Learning the fundamentals of spur and helical gear design, along with hands-on experience in gear correction methods.
- Gaining insight into the materials used for gears, their selection criteria, and heat treatment processes.
- Participating in a live demonstration of gear inspection and manufacturing.

Targeted Audience:
Practicing Engineers, Scientists, Design Engineers, Manufacturing Engineers, Industry Professionals and Faculty members.

Course Code:1102

Course Title: Design for Manufacturing & Assembly

Brief Overview:
Design for manufacture and assembly techniques address issues related to product manufacturing and assembly during design stage. It is said that about 70% of product is decided during the design stage itself. DFMA techniques call for team work and result in enhanced product performance. DFMA techniques help in reducing the cost of a product, number of iterations and time to market. It helps in improving the quality of the product and its reliability during service. DFMA techniques are being used by number of organizations to develop the product at first attempt.

Focused Areas:
- Introduction to Design for Manufacture and Assembly
- Design for Manufacture guidelines
- Design for Assembly guidelines
- Design for Rapid prototyping guidelines
- Material selection approach
- DFMA case studies.

Key Takeaways:
- Exploring Design for Manufacture and Assembly guidelines
- Assessing assembly design efficiency through practical examples
- Gaining an understanding of material selection
- Learning rapid prototyping techniques for DFM
- Engaging in a live demonstration of design for manufacture and material selection.

Targeted Audience:
Design Engineers and Assembly & Testing Engineers.

Course Code:1301

Course Title: Measurement Uncertainty for Chemical & Mechanical Parameters by Guide for Uncertainty Measurement (GUM) Method

Brief Overview:
Calculating measurement uncertainty according to ISO 17025 is essential for demonstrating competence, improving accuracy and reliability, building client confidence, facilitating data comparison and interpretation and meeting regulatory requirements. It is a fundamental aspect of quality management in testing and calibration laboratories. Understanding uncertainty in measurements ensures accuracy, improves quality control and aids in compliance with international standards. It helps reduce costs, manage risks and drive continuous improvement in testing methods and overall quality. This course aims to provide participants with comprehensive knowledge and practical skills in evaluating measurement uncertainty for the chemical composition and mechanical parameters of metals following the Guide for

Uncertainty Measurement (GUM) method. Participants will learn the theoretical background, mathematical concepts and practical applications of GUM in testing and calibration.

Focussed Areas:

•Understanding the basic concepts and principles of measurement uncertainty
•Identifying and categorizing different types of uncertainties that can affect measurements
•Learning essential terminologies such as degrees of freedom, standard deviation, coverage factor, confidence level and distribution factors (Normal, Triangular, Rectangular)
•Recognizing the parameters that influence measurement uncertainty
•Analysing typical case studies for estimating uncertainty in chemical composition analysis of metals (spectroscopy) and mechanical parameters (hardness and tensile tests)

Key takeaways:

•Understand the theoretical concepts of measurement uncertainty and the principles of the Guide to the Expression of Uncertainty in Measurement (GUM).
•Evaluate and express measurement uncertainty for chemical composition and mechanical properties – tensile & hardness measurement.
•Practical guidance on applying GUM principles in testing and calibration.

Targeted Audience:

Laboratory technicians and analysts, Quality control personnel, Engineers involved in materials testing, Managers and supervisors responsible for laboratory operations, Anyone seeking to improve the accuracy and reliability of their metals testing processes

Course Code:1302

Course Title: Chemical Testing & Characterization of Metallic Materials

Brief Overview:

The course offers a comprehensive insight as well as overview on various testing and characterization techniques used for study of metallic materials. The capabilities and limitations of each technique as with respect to analysis will be discussed. This would enable to specify and choose characterization techniques based on the analysis requirement. The leverage of information on the standard testing and characterization methods for chemical characterization of metallic materials will be made available for the participants thereby signifying the role of chemical characterization of metallic materials. Demonstration of the characterization and testing tools such as Optical Emission Spectrometer, Wavelength Dispersive X-ray Fluorescence Spectrometer, Oxygen Nitrogen Hydrogen Analyzer and Carbon Sulfur Analyzer specifically for metallic materials used in the form of bulk/coatings in industrial applications will be focussed.

Focussed Areas:

The course aims at providing detailed training on testing and characterization qualification of raw materials deployed in engineering applications. The significance of material composition testing the basic criteria for qualification of raw materials in manufacturing will be emphasized. It also aims at imparting knowledge and experience sharing on testing and characterization of metallic materials.

Targeted Audience:

Testing, Quality, Manufacturing & Inspection Engineers

Course Code:1303

Course Title: Non-Destructive Testing

Brief Overview:

Non-Destructive Testing (NDT) refers to flaw detection in raw materials as well as in finished components as part of qualification test involved before and after production process. The defects present in raw materials and components will cause catastrophic failure of components during manufacturing as well as service. Further, NDT technique is also adopted as part of machine conditioning and monitoring activities. The four extensively adopted processes are Dye Penetration Test, Magnetic particle Test, Ultrasonic Test and Radiography testing. Knowledge on these helps to identify and select appropriate technique for Non-destructive evaluation.
The course objective is to make the mechanical/metallurgical engineers aware of the NDT techniques and its importance in qualifying the raw materials and finished components. Knowledge on this helps the engineers to select the suitable NDT method to evaluate the component quality levels.

Focussed Areas:

- Significance of performing NDT in engineering applications
- Principles & applications of Dye Penetration Test (DPT)
- Principles & applications of Magnetic Particle Test (MPT)
- Principles & applications of Ultrasonic Test (UT)
- Principles & applications of Radiography Testing (RT)
- Discussion on applicable national or international standards/codes for practicing the above-mentioned NDT method

Targeted Audience:

This course is ideal for design engineers, production engineers, quality engineers, and other professionals who need to work with metals and alloys in their roles.

Course Code:1304

Course Title: Corrosion and its prevention through Surface Finishing

Brief Overview:
Corrosion is an undesirable phenomenon which occurs on surface as well as sub-surface of all kinds of metallic materials due to surface interaction with the environment. It plays a vital role in deciding the service life of any metallic component. Though it is not possible to prevent its occurrence however, it can be minimized through protection of surface by finishing and alloying. This will improve the economical use of machine tools. To impart knowledge on the various corrosion phenomena occurring and the measures adapted to minimize corrosion thereby extending the service life of metallic engineering components

Focussed Areas:
- Definition of corrosion
- Types of corrosion
- Mechanism of corrosion (thermodynamics & kinetics)
- Techniques/Methods to combat corrosion
- Evaluation of corrosion resistance property of surface finished components
- Case studies

Targeted Audience:
For maintenance engineers (mechanical & civil) and personnel involved in failure analysis & mechanical testing

Course Code:1305

Course Title: Materials & Metallurgy for Non-Metallurgists

Brief Overview:
Basic knowledge of materials and metallurgy facilitates better communication and collaboration in multidisciplinary teams and equips professionals to efficiently solve material-related issues. Overall, this knowledge is a valuable asset for improving the quality, innovation, sustainability and efficiency of work. The "Materials & Metallurgy for Non-Metallurgists" course is designed to provide essential metallurgical knowledge to engineers and professionals who do not have a background in metallurgy. This course aims to help participants understand the basics of metallurgy, including the properties, behaviors, and processing of metals and alloys.

Focussed Areas:
- Introduction to engineering metals and alloys
- Roles of various alloying elements
- Metal atomic structures and their importance
- Classifications of metals and alloys, including phase diagrams
- Ferrous metallurgy (steel, cast iron)
- Heat treatment of ferrous and non-ferrous alloys

Key take aways:
- Understand the basics of metallurgy
- Identify and classify metals and alloys
- Understand the metallurgical changes during heat treatment
- Select appropriate metals and alloys for specific applications
- Develop processes to achieve desired metallurgical properties

Targeted Audience:
This course is ideal for design engineers, production engineers, quality engineers, mechanical engineers, and other professionals who need to work with metals and alloys in their roles.

Course Code:1306

Course Title: Advanced Material Testing

Brief Overview:
Designers select the material considering the design aspects & the functional requirement. Once the material is identified and purchased it is to be tested for chemical composition and physical properties to establish its suitability for the intended application. The testing laboratory plays an important role in furnishing quality result. Quality result can be achieved through selection of appropriate test methods and possessing adequate technical knowledge by the technician/chemist. Several methods are available for conducting chemical and metallographic tests which have different accuracy and repeatability limits.

Focussed Areas:
- Factor which influences accuracy & repeatability.
- Selection of test methods

Targeted Audience:
- Laboratory technicians and analysts
- Quality control personnel
- Engineers involved in materials testing
- Managers and supervisors responsible for laboratory operations
- Anyone seeking to improve the accuracy and reliability of their metals testing processes

Course Code:1307

Course Title: Materials Metallurgy and Heat Treatment of Metals and Alloys

Brief Overview:
Heat Treatment is a core manufacturing process carried out under controlled application of temperature and atmosphere to optimize certain physical and mechanical properties of metals/alloys. Heat treatment is an enabling process that improves product performance by increasing its strength or other desirable characteristics such as machinability, formability, ductility, etc. Heat treatment is an essential step in manufacturing process, typically performed at the end to ensure the desired product specifications are met. Its significance lies in its ability to meet design requirements while minimizing the risk of non-conformance or rejection which can prove costly in later stage of production The process of heat treatment has a wide application in many industries such as Automobile & Auto Components, Dies & Mould, Machine Tools, Aerospace and General Engineering.

Focussed Areas:
- Fundamentals & Purpose
- Selection of materials based on Heat Treatment process
- Risk management in Heat Treatment process (FMEA)
- Design of Heat Treatment cycle based on the design requirement (Performance characteristics)
- Basic Heat Treatment Processes (Annealing, Normalizing, Hardening, Quenching, Tempering, Case Carburizing & Hardening, Case Nitriding, Sub-zero Treatment, Induction Hardening)
- Advance Techniques of Surface Heat Treatment
- Techniques of distortion control
- Successful drawing requirements
- General Quality plan of Heat Treatment for acceptance / rejection
- Industry Practices
- Understanding of case depth determination (Carburizing, Nitriding & Induction hardening, particularly in case of components like gear, shafts plane & spline)
- Common failures & remedies

Key take aways:
- Learn about various heat treatment methods and specific applications of each process
- Develop Quality plan for critical heat-treated components
- Understand how to calculate and control case depth in surface hardening
- Understand common problems encountered in heat treatment and remedies

Targeted Audience:
This course is ideal for design engineers, production engineers, quality engineers, mechanical engineers, and other professionals who need to work with metals and alloys in their rolesto work with metals and alloys in their roles.

Course Code:1308

Course Title: Advanced Engineering Materials Testing & Characterisation

Brief Overview:
Development of Advanced Engineering Materials signifies the need for testing and characterization for their deployment in Engineering Applications. The course comprises of characterization and testing of engineering materials by Wavelength Dispersive X-ray Spectrometer (WDXRF), X-ray Diffractometer (XRD), Carbon Sulfur & Oxygen Nitrogen Hydrogen Analyzers as per standard requirements. Detailed mechanical characterization of materials including Hardness, Tensile and Impact strength will be discussed. Nondestructive evaluation of weldments and forgings by Phased Array Ultrasonic Testing (PAUT) will be detailed. The salient features of the advanced systems will be demonstrated and experience sharing on the technical implication with respect to the usage of the materials in engineering applications will be emphasized.

Objectives:
The course aims at imparting knowledge and experience sharing on testing, characterization and qualification of engineering materials. The significance of material testing (composition, mechanical and NDT) the basic criteria for qualification of raw materials in manufacturing and failure analysis inspection of finished components will be emphasized

Targeted Audience:
Testing, Quality & Inspection Engineers

Course Code:2101

Course Title: Single Point Diamond Turning (Machine Technology and Characterization Techniques

Brief Overview:
Single point Diamond Turning (SPDT) is an ultra precision machining technology. SPDT requirements are increasing day by day to meet the demands in the country for production of ultra precision components having optical quality. CMTI with its decades of expertise in SPDT machine and process developments, has tailored this basic course on SPDT, to provide a classroom teaching to engineers and operators to understand the basics of SPDT machine and its process for effective operation of the machine. In this course, topics related to the SPDT technologies for operation & characterizations of SPDT components are covered.

Key takeaways:
1.Comprehensive Understanding of SPDT

- Gain foundational knowledge about Single Point Diamond Turning (SPDT) as an ultra-precision machining technology.
- Learn about the growing demand for SPDT in producing optical-quality components.

2.SPDT Machine Technology and Operation
- Explore the advanced features and operational principles of SPDT machines.
- Understand the technological capabilities that make SPDT a critical tool for ultra-precision manufacturing.

3.Process Technology Insights
- Study the critical tool parameters, tool setting techniques, and process parameters that influence SPDT performance.
- Learn the systematic approach to optimize SPDT operations for achieving desired precision and quality.

4.Machining Demonstrations
- Participate in demonstrations of SPDT processes, including tool setup and operational procedures.
- Acquire practical insights through real-time exposure to machine operation and process execution.

5.Introduction to Freeform Machining
- Get an overview of Fast Tool Servo (FTS) technology, enabling complex freeform machining capabilities in SPDT.

6.Metrology and Component Characterization
- Understand the metrology aspects of SPDT, focusing on dimensions, form accuracy, and surface finish.
- Witness demonstrations on characterizing SPDT components using advanced metrology tools and techniques.

7.Industry-Relevant Skill Development
- Develop skills essential for engineers and operators in the precision machining industry.
- Equip yourself with the knowledge needed to effectively operate SPDT machines and ensure the production of ultra-precision components.

This course is tailored by CMTI, leveraging decades of expertise, to bridge the knowledge gap and empower participants to meet the ever-increasing demands for ultra-precision manufacturing.

Targeted Audience:

SPDT machine operators and engineers of Electro-optics industry, LED and lighting mold manufacturers, ophthalmic industries, strategic sectors, precision manufacturing industries.

Course Code:2201

Course Title: Industry 4.0 & Smart Manufacturing Systems

Brief Overview:

Smart manufacturing is a modern approach to manufacturing that integrates advanced technologies, data analytics, and automation to improve production processes, enhance efficiency, and reduce costs. It is an evolution of traditional manufacturing processes, where smart technologies such as sensors, robotics, artificial intelligence (AI), and the Internet of Things (IoT) are used to create a more responsive and flexible manufacturing environment.

Smart manufacturing focuses on real-time data collection and analysis, allowing manufacturers to monitor and optimize production processes, predict maintenance needs, and improve product quality. It is often associated with the concept of a "connected factory," where machines, devices, and systems communicate with each other, making operations more streamlined and adaptable.

CMTI, under the SAMARTH Udyog Bharat 4.0 Platform of the Ministry of Heavy Industries (MHI), has set up a Smart Manufacturing Demo & Development Cell as a Common Engineering Facility Centre (CEFC) to propagate and support the process of adoption of smart manufacturing practices by the rapidly growing Indian manufacturing industry.

CMTI's training program on Smart Manufacturing and Industry 4.0/5.0 aim to equip participants with the essential skills, knowledge, and tools to implement and optimize Industry 4.0/5.0 technologies within their organizations. These programs combine theoretical learning with practical insights, helping participants understand how to implement automation, data analytics, IoT, robotics/cobots, AI, and other advanced manufacturing technologies in real-world manufacturing settings.

Focussed Areas:

1) Introduction to Smart Manufacturing & Industry 4.0/5.0
- Concepts of Industry 4.0/5.0: Understanding the evolution of the industrial revolution and how Industry 4.0/5.0 differs from its predecessors.
- Core Technologies: Learning about the key technologies driving Industry 4.0/5.0, including IoT, AI, Cyber-Physical Systems (CPS), robotics/cobots, big data, and cloud computing.
- Smart Manufacturing Systems: Understanding the role of smart factories, automation, and digital twins in modern production environments.

2) IoT (Internet of Things) in Manufacturing(Digitization of Legacy Machines and Machine to Machine connectivity:
- Connectivity and Sensors: How IoT devices and sensors are used to collect real-time data in manufacturing environments.
- Data Integration and Communication: Methods for integrating devices and machines with Opcua and MT Link for real-time monitoring and decision-making.
- IoT Protocols and Platforms: Overview of IoT communication protocols (TCP/IP, HTTP, MQTT, OPC UA etc.) and cloud-based IoT platforms.

3) Artificial Intelligence (AI) and Machine Learning (ML) for Manufacturing:
- AI in Predictive Maintenance: Leveraging machine learning algorithms to predict equipment failure and optimize maintenance schedules.
- Quality Control with AI: Applying AI and computer vision for quality inspection and defect detection.
- Process Optimization: Using AI to enhance process efficiency, reduce energy consumption, and improve product quality.

4) Machine Vision and its Applications
- Introduction to Machine Vision in Manufacturing
  - What is Machine Vision
  - Machine vision system components
- Principles of Image Processing and Analysis
  - Fundamentals of Image Acquisition
  - Image Processing Algorithms
- Applications of Machine Vision in Smart Manufacturing
  - Quality Control and Inspection
  - Assembly Verification
  - Robotics and Automation
  - Process Monitoring and Control
- Hands-on Experience and Practical Applications
  - Lab Work and Simulations
  - Case Studies and Industry Application

5) Robotics and Automation:
- Collaborative Robots (Cobots): Training on the use of robots that work alongside human operators to improve safety and efficiency in manufacturing (human-robot collaboration).
- Automated Mobile Robot (AMR): Understanding the role of AMR in material handling and production flow.

6) Data Acquisition for IoT, Edge Devices in Manufacturing:
- Introduction to Industrial IoT (IIoT)
  - Overview of IIoT
  - IIoT Architecture
- Data Acquisition Systems (DAQS) in IIoT
  - What is Data Acquisition?
  - Sensors and Actuators
  - Signal Conditioning and Data Conversion
- Edge Computing in Industrial IoT
  - What is Edge Computing?
  - Edge Devices and Gateways

7) Digital Twins and Virtual Simulation:
- Creating Digital Twins: How digital twins enable virtual modeling and simulation of physical assets or processes for optimization.
- Virtual Prototyping: Using simulation tools to test and iterate designs or processes before actual implementation.
- Real-Time Monitoring and Control: Using digital twin technology for continuous monitoring and performance management.

8) Smart Sensors and controllers
- Introduction of Smart sensors and controllers
  - Definitions and overview of sensors ,controllers
  - Importance of Smart Sensors and Controllers in Smart Manufacturing
- Types of Smart Sensors Used in Smart Manufacturing
- Working Principles of Smart Sensors
  - Sensing Technologies
  - Data Acquisition and Signal Processing
- Controllers in Smart Manufacturing

9) Augmented Reality & its Applications
- Introduction to Augmented Reality (AR)
  - What is Augmented Reality (AR)
  - AR vs. Traditional Manufacturing Technologies
- Core Technologies Behind AR in Manufacturing
  - Hardware Used for AR in Manufacturing
  - Software and Platforms
  - Communication and Connectivity
- AR Applications in Smart Manufacturing
  - Assembly and Manufacturing Process Assistance
  - Maintenance and Repair Assistance
  - Quality Control and Inspection
  - Training and Skill Development

10) Condition monitoring of machines for predictive maintenance
- Key Components of Condition Monitoring
  - Sensors
  - Data Acquisition Systems
  - Condition Monitoring Software
  - Diagnostic Tools
- Types of Condition Monitoring Techniques

- Vibration Analysis
- Data Collection & Analysis
- Predictive & Proactive Maintenance
- Techniques for Condition Monitoring
- Vibration Monitoring for Predictive Maintenance
- Fault Analysis
- Few Case Studies & Benefits

11) Smart Metrology
- Introduction to metrology
- Evolution of general philosophy on metrology and
- Fundamentals of metrology
  - Basic Terminologies
  - Measurements Standards
  - Absolute standards

12) Precision Machine Tool Aggregates and Their Relevance in Smart Manufacturing
- Precision & reliability
- Lubrication & NVH
- Thermal stability
- Friction less bearing
- Industry 4.0 solutions

13) Reverse Engineering Introduction
- Introduction
  - Definition
  - Importance
  - Need
  - Application
- Hardware and Software
- Reverse Engineering Process
- 3D Scanning Process

14) Inventory/Asset Management Using RFID Technology
- Radio Frequency Identification (RFID) vs Existing Conventional Technologies
- Basic RFID System & Working Principle (Identification, Tracking, Tracking, Sensing)
- Illustration of Use cases

15) Hands-on Practical Training
- Hands on PLC data retrieval with Open-source software
- Collaborative Robots use cases
- Hands On Session On TCP/IP, HTTP, MQTT, OPC UA, Open-Source Tools for Data flow Management for IoT (Apache NiFi)

16) Demonstrations
- IIOT Implementation at workshop
- Data Acquisition & control strategies for Smart Manufacturing IIoT
- Condition monitoring
- Reverse engineering & Smart tool holder
- Smart Metrology.

Key Takeaways:
- Understand the Fundamentals of Industry 4.0/5.0
- Implement Smart Manufacturing Technologies
- Design and Develop Smart Factories
- Utilize Industry 4.0/5.0 Software and Tools
- Evaluate the Impact of Industry 4.0/5.0 on the Workforce

Targeted Audience:
- The Smart Manufacturing & Industry 4.0/5.0 course is designed to benefit a diverse range of professionals and organizations across multiple industries. The targeted audience includes individuals who are involved in manufacturing, engineering, operations, IT, and management roles and are looking to understand or implement Industry 4.0/5.0 technologies.
- Industry professionals from MSME's
- Government & Private Industries
- Faculty/Students (above UG 3rd year) from Academic Institutes

Course Code:2202

Course Title: Advanced Robotics

Brief Overview:
In Smart Manufacturing and Industry 4.0, Advanced Robotics (cobots) are playing a pivotal role by revolutionizing how production systems operate. These robots, which are designed to work safely alongside humans, enhance productivity, flexibility, and efficiency in the

manufacturing process. Industry 4.0, the fourth industrial revolution, emphasizes the integration of digital technologies, automation, data exchange, and artificial intelligence (AI) in manufacturing processes. Cobots, as part of this transformation, support various goals, such as increasing automation, optimizing supply chains, and improving product quality.

CMTI, under the SAMARTH Udyog Bharat 4.0 Platform of the Ministry of Heavy Industries (MHI), has set up a Smart Manufacturing Demo & Development Cell as a Common Engineering Facility Centre (CEFC) to propagate and support the process of adoption of smart manufacturing practices by the rapidly growing Indian manufacturing industry.

CMTI had a Advanced Robotics Lab is an innovative environment where the future of human-robot collaboration is actively explored, with a focus on practical applications that improve productivity, safety, and efficiency across various industries. The continuous advancement of technologies like AI, machine learning, and computer vision ensures that cobots are increasingly able to perform complex tasks alongside humans, creating a more harmonious and productive workplace. .

Focused Areas:

1) Introduction to Advanced Robotics
   - Definition of Adavnced Robotics (Cobots)
   - Purpose of Cobots in Modern Industry
   - Why Cobots?
   - Cobots vs. Traditional Robots
2) Historical Development and Market Trends of Cobot
   - Historical Development of Robots
   - Emergence of Advanced Robots (Cobots)
   - Key Milestones in Cobot Evolution
   - Current Market Trends and Future Prospects
3) Types of Collaborative Robots
   - Power and Force Limiting Cobots
   - Speed and Separation Monitoring Cobots
   - Hand-Guided Cobots
   - Safety Monitored Stop Cobots
4) Key Components and Subsystems of Cobots
   - Sensors in Cobots
   - Actuators
   - End-Effectors
   - Control Systems
5) Safety Features and Standards for Cobot
   - Safety Standards
   - Built-in Safety Features in Cobots
   - Risk Assessment for Cobots
6) Programming and Path Planning for Cobots
   - Basic Cobot Programming
   - Path Planning Algorithms
   - Artificial Intelligence (AI) and Machine Learning in Cobots
   - Real-world examples of Cobot Programming
7) Applications of Cobots in Industry
   - Manufacturing and Assembly
   - Automotive Industry
   - Healthcare
   - Logistics and Warehousing
   - Food and Beverage Industry
8) Integration of Cobots in Smart Factories and Industry 4.0
   - Cobots and Smart Manufacturing
   - Interoperability and Connectivity
   - Predictive Maintenance and Monitoring
   - Case Study: Cobot Deployment in a Smart Factory
9) Challenges and Future of Cobots
   - Challenges in Cobot Implementation
   - Future of Cobots
   - Emerging Applications
10) Hands-on Practical Training
   - Identification of Components and Understanding functions
   - Electrical Interface
   - Safety Recovery
   - Manual Operation
   - Configuration
   - Creating Sample Programs

Key takeaways:

- Learn about the unique features and capabilities of cobots, as well as the safety protocols and best Practices for working with them.
- Advanced Robotics basic training typically covers topics such as cobot programming, risk assessments, safety measures, and Troubleshooting.
- Overall, Advanced Robotics basic training is an essential step for anyone who wants to enter the field of cobot automation. With the right training and knowledge, individuals can confidently integrate cobots into their workplace and take advantage of the many benefits that these machines offer

Targeted Audience:

The Advanced Robotics course is designed to benefit a diverse range of professionals and organizations across multiple industries. The targeted audience includes individuals who are involved in manufacturing, engineering, operations and are looking to understand or implement Industry 4.0/5.0 technologies.

- Industry professionals from MSME's
- Government & Private Industries
- Faculty/Students (above UG 3rd year) from Academic Institutes

Course Code:2203

Course Title: AI & ML for Manufacturing Industries

Brief Overview:

This course provides a comprehensive understanding of Artificial Intelligence (AI) and Machine Learning (ML) applications in manufacturing. It covers key concepts, techniques, and real-world implementations to optimize production, enhance quality control, predictive maintenance, and streamline supply chain operations. Participants will gain practical insights into AI-driven automation, smart diagnostics and smart factory solutions.

Module 1: Introduction to AI & ML in Manufacturing

- Overview of AI & ML
- Key Applications in Manufacturing
- Benefits & Challenges

Module 2: Core AI & ML Techniques

- Supervised, Unsupervised & Reinforcement Learning
- Data Collection & Processing
- AI Models for defect identification, Predictive Maintenance & Quality Control

Module 3: AI-driven Automation & Smart Factories

- AI in Industrial Robotics/ Cobots and AMR
- Digital Twins
- Supply Chain Optimization with AI
- Production Planning & Scheduling – Process Prognostics, Autonomous Quality Management

Module 4: Implementation & Future Trends

- Customer Sentiment Analysis in Electric Vehicle Market – Case Study - Extract EV customer reviews using web scraping.
- Classify sentiments (positive, neutral, negative) with NLP.
- Generate word clouds to identify key preferences.
- Analyze insights for better decision-making.
- Steps to AI Adoption in Manufacturing
- Overcoming Implementation Challenges
- Future Innovations & Workforce Upskilling

Key takeaways:

At the end of the course, participants will be able to:

- Understand the fundamentals of AI & ML and their role in manufacturing.
- Identify key applications and benefits of AI-driven solutions.
- Utilize AI models for defect identification, predictive maintenance and quality control.
- Implement AI in automation, robotics, and smart factories.
- Navigate the steps for AI adoption and address implementation challenges.
- Stay informed about future AI trends and workforce upskilling needs.

Targeted Audience:

- Manufacturing professionals seeking to integrate AI & ML in operations
- Engineers and technicians involved in automation, maintenance, quality assurance and process optimization.
- Supply chain managers looking to leverage AI for efficiency.
- Professionals implementing AI solutions in manufacturing.
- Business leaders and decision-makers exploring AI-driven strategies.
- Faculty/students from Academic Institutes

Course Code:2301

Course Title: Nano Materials Characterization SEM, XRD, SPM, Nano Indenter, etc

Brief Overview: This training covers essential techniques for advanced materials characterisation, beginning with an introduction to analytical methods, selection criteria, and applications. Course covers analytical technics such as FESEM and EDS, confocal microscopy, SPM (AFM/STM), optical profiler, nanoindentation, XRD, Raman and FTIR spectroscopy, particle size analyser, surface area analyser, rheometers and spectroscopic ellipsometer. The course integrates these techniques through data correlation, live demonstration with instruments and case studies. This comprehensive program equips participants with practical skills and theoretical knowledge for advanced materials research and applications.

Key takeaways:

FESEM, Confocal Microscopy, SPM (AFM/STM), Optical Profiler, Nanoindentation, XRD, Raman and FTIR Spectroscopy, Particle Size Analyzer, Surface Area Analyzer, Rheometer and Spectroscopic Ellipsometer.

Targeted Audience:

Researchers, Scientists, Metallurgists, Scientific/ Engineering Officers, Quality Managers, Laboratory Technicians, Consultants, Semiconductor Laboratories, Research Laboratories, Quality/Testing Laboratories and Analytical Laboratories.

Course Code:2302

Course Title: Machinery Condition Monitoring for Predictive and Proactive Maintenance

Brief Overview:

Machinery maintenance strategies are changing fast in tune with the modern manufacturing methods and systems. Reduction of down time, minimizing unforeseen stoppages, reduction in spares, inventory are becoming essentials of good maintenance management. This is lead to an increased emphasis on new techniques and methods such as predictive and proactive maintenance practices.

The course is focused on the current trends in maintenance with an emphasis on predictive and proactive maintenance methods. Predictive maintenance of rotating machinery through various vibration monitoring techniques and oil analysis techniques for predictive and proactive maintenance, data analysis for decision making and on-line condition monitoring etc., are covered in detail with practical demonstrations and presentation of case studies.

Focussed Areas:

- Overview of Maintenance Strategies and Condition Monitoring Concepts.
- Fundamentals of Noise and Vibration.
- Instrumentation for Noise and Vibration Measurement and Analysis.
- Vibration Monitoring for predictive maintenance
- Vibration Monitoring of Rotating Machinery.
- System Analysis
- Condition Monitoring Case Studies.
- Dynamic Balancing (on balancing machine and in-situ balancing).
- Simulation of Various Faults in Machinery Fault Simulator and Fault Analysis.

Key takeaways:

Basics of Noise and Vibration, Instrumentation for Condition Monitoring, Condition Monitoring Techniques and Parameters, Sensor mounting techniques and Data Collection, Vibration Monitoring of Rotating Machinery, Interpretation of vibration spectrum, Fault analysis in rotating machinery, Real-time condition monitoring and data analytics for predictive maintenance, Simulation of various faults like unbalance, misalignment, bearing faults, bent shaft, eccentric rotor, mechanical looseness etc., in Machinery Fault Simulator and Analysis. Dynamic Balancing (single and two plane). Identification of Natural/resonance frequencies. Critical speed analysis.

Targeted Audience:

Engineers/Managers from Maintenance Departments/Groups, Production and Quality Departments. Diploma Holders from Maintenance departments/groups. Fresh Engineers and Diploma holders interested in Predictive and Proactive Maintenance. .

Course Code:2303

Course Title: Noise & Vibration Analysis Methods

Brief Overview:

Noise and Vibration is becoming a key attribute that the engineers have to take into account to deliver high quality product. The course is designed to provide theoretical and practical knowledge in measurement, analysis and mitigation of noise and vibration in machines, automobiles, house hold appliances etc. The course is aimed to help engineers to gain sufficient knowledge to do trouble shooting of NVH Problems in machines, automobiles and appliances. Noise and Vibration measurement methods, instrumentation, standards, analysis- Basic and Advanced analysis techniques such as Bearings, Gear Box Analysis, Vibro Acoustic Analysis, Order Tracking, FRF, Sound Power, Sound Intensity Analysis and Noise Source Ranking etc., will be covered in detail with practical demonstration and presentation of case studies.

Focussed Areas:
Fundamentals of Noise and Vibration.
Instrumentation for Noise and Vibration Measurement and Analysis.
Fourier Analyser and its applications.
Vibration Monitoring
Advanced Noise and Vibration Analysis.
Vibration Mitigation.
Dynamic Balancing (on balancing machine and in-situ balancing)
Sound Power and Sound Intensity, Noise Mapping and Ranking of Sources

Key takeaways:
Basics of Noise and Vibration, Instrumentation for Noise and Vibration Measurement, Noise and Vibration Measurement and Analysis, Dynamic Balancing, FRF Measurements, FFT Analysis, Waterfall diagram, Order Tracking, Sound Pressure and Sound Power Measurement, Sound Intensity Analysis, Noise Source Mapping and Ranking.

Targeted Audience:
Engineers/Managers from NVH Testing Domain/Groups, Product Development Group, Research and Development Group, Maintenance and Quality Departments.

Course Code:2304

Course Title: Microscopy & Analysis: SEM, AFM, STM, Confocal Microscope, Optical Profiler etc

Brief Overview:
The 'Microscopy & Analysis' training covers principles, instrumentation, and applications of SEM, SPM (AFM/STM), Optical Profiler, Confocal Microscopy, Metallurgical Microscope providing a strong foundation in material characterization. It includes insights into sample preparation, imaging, and data interpretation, with live demonstration and real-world case studies to bridge theory and practice for research and industrial applications.

Key takeaways:
FESEM, SPM (AFM/STM), Optical Profiler, Confocal Microscopy and Metallurgical Microscope.

Targeted Audience:
Researchers, Scientists Metallurgists, Scientific/ Engineering Officers, Quality Managers, Laboratory Technicians, Consultants, Semiconductor Laboratories, Research Laboratories, Quality/Testing Laboratories and Analytical Laboratories.

Course Code:2305

Course Title: Scanning Electron Microscopy

Brief Overview:
The 'Scanning Electron Microscopy' training focuses on FESEM principles, instrumentation, and imaging techniques, offering a solid understanding of micro and nano-structural analysis. It includes detailed guidance on sample preparation methods to ensure high-quality imaging and practical insights into data interpretation for research and industrial applications.

Key takeaways:
Field Emission Scanning Electron Microscopy (FESEM), Energy Dispersive X-ray Spectroscopy (EDS), Sample Preparation.

Targeted Audience:
Researchers, Scientists, Metallurgists, Scientific/ Engineering Officers, Quality Managers, Laboratory Technicians, Consultants, Semiconductor Laboratories, Research Laboratories, Quality/Testing Laboratories and Analytical Laboratories.

Course Code:3101

Course Title: Design and analysis of Experiments for Microsystems design and processes

Brief Overview:
This course provides a structured approach to designing and analysing experiments specifically for microsystems design and fabrication processes. Participants will gain expertise in experimental design methodologies tailored to MEMS and microsystem applications, ensuring efficient data collection, analysis, and optimisation. The course covers fundamental and advanced topics, including full and fractional factorial designs, Taguchi methods, analysis of variance (ANOVA), and multi-objective optimisation. Special emphasis is placed on understanding the role of experimental design in microscale processes, the significance of orthogonality, and statistical modelling techniques.

Key Takeaways
Through case studies and hands-on exercises, participants will learn to optimise design parameters, analyse factor interactions, and apply hypothesis testing for robust and efficient microsystem development

Targeted Audience:

This course is ideal for engineers, researchers, and academics working in MEMS and microsystem domains, providing them with the essential skills to conduct high-impact experimental studies

Course Code:3102

Course Title: Training on Welding Technologies for Vacuum-Based Systems

Brief Overview:
Welding is a fundamental manufacturing process widely used in various industries to join materials, typically metals or thermoplastics, by coalescing them under the application of heat, pressure, or both. This process is essential in sectors such as construction, automotive, aerospace, Sensor packaging, shipbuilding, and energy production, where structural integrity and material performance are crucial. This two-day training program provides an in-depth understanding of welding technologies essential for vacuum-based systems. Vacuum-based systems require precision welding techniques to ensure structural integrity, minimal outgassing, and leak-proof performance. This specialized two-day training program focuses on the fundamental and advanced aspects of welding technologies used in vacuum applications.

Key Takeaways
Participants will gain insights into material selection, surface preparation, and welding processes such as TIG welding, electron beam welding, and laser welding, which are critical for achieving high vacuum integrity. The course will also cover the common weld defects, surface, sub-surface and volumetric defects, that can come up during welding. These defects include porosity, spatter, surface crack, inclusions, incomplete fusion, blow holes, incomplete penetration, etc. understand their causes, and implement effective corrective and preventive measures. An information on various destructive and non-destructive techniques available to characterize the defects. Through interactive sessions, practical demonstrations, and case studies, attendees will develop a strong foundation in vacuum welding technology, ensuring their ability to apply best practices in industries such as aerospace, semiconductors, scientific instrumentation, and nuclear research

Targeted Audience:
This training is ideal for Engineers, Technicians, and Professionals involved in the design, fabrication, and maintenance of vacuum-based systems

Course Code:3103

Course Title: Semiconductor Design and Fabrication processes

Brief Overview:
Micro Electro Mechanical Systems (MEMS) is the integration of mechanical elements / structures, sensors, actuators and electronics on a common silicon substrate through micro fabrication and micro system technologies (MEMS). The MEMS devices being developed using this MEMS technology needs to be designed considering all the parameters and conduction principles suiting to specific application using software tools such as Coventorware, ANSYS and Cadense. Further the MEMS devices with micro structures are to be fabricated using compatible micro machining processes such as lithography process for pattern transfer, deposition process to create new structural layers over silicon wafer and etching process to selectively etch way parts of silicon wafer in the MEMS devices.

Key Takeaways
This course will provide in-depth knowledge in the MEMS design and fabrication processes and get acquainted with equipment's used for MEMS fabrication processes. The participants will learn to design the MEMS devices of their interest with optimised parameters and also to arrive at fabrication processes.

Targeted Audience:
Engineers, Researchers and Academia's working in the field of designing and fabricating MEMS and micro devices

Course Code:3104

Course Title: Semiconductor Packaging and Characterization Processes

Brief Overview:
Semiconductor packaging involves encapsulating micro devices or microsystems, such as MEMS (Micro-Electro-Mechanical Systems) sensor or electronics chip, to provide protection, electrical connections, and effective heat management, ensuring their proper integration into larger systems. It enables the chip to interact with external components while maintaining reliability and performance. Semiconductor characterization is the process of testing and evaluating a device's electrical, thermal, and mechanical properties to ensure it meets specifications and performs reliably for applications like sensors, actuators, and microelectronics. The main objective of the course to help new researchers to provide platform to get familiarize with processes steps involved in semiconductor packaging and characterization methods. It will give a fair idea about choice of packing methods and materials based on device type, form factor requirement, environmental condition and application area. This course will also cover the advanced packaging techniques like flip chip bonding, Wafer level packaging and 3-D Packaging.

Focussed Areas:
Basic and advanced semiconductor Packaging Flow, Electrical, Mechanical, Material Characterization

Key Takeaways
- Packaging fundamentals
- In-depth Understanding of Packaging and Characterization Techniques:
- Selection of Packaging method and Characterization techniques and their applications

- Future trends for Industry-Relevant Applications:.

Targeted Audience:
Research Students, Scientists, Engineers, Faculty working in the domain of semiconductor and MEMS technology

Course Code:4101

Course Title: Laboratory Management and Internal Audit as per ISO/IEC 17025:2017

Brief Overview:
Various accreditation body like NABL provides laboratory accreditation services to all laboratories performing calibration / testing. To get accredited by these accreditation bodies, the laboratories should be able to demonstrate that they operate a quality management system, technical competence and are able to generate technically valid results, compliance with international standard ISO/IEC 17025:2017. The course covers General, Structural, Resource, Process and Management System requirements of a calibration/testing laboratory based on ISO/IEC 17025:2017, covering all the clauses. The course provides insight into all the requirements of standard with regard to preparation of documents (quality manual, work procedures, calibration procedures), establishing traceability of measurements through reference standards, estimation of uncertainty of measurements, internal audit and management review.

Key takeaways:
The participants will be able to develop and implement quality management system, preparation of documents including quality manual, plan and conduct internal audits as per ISO/IEC 17025:2017

Targeted Audience:
Quality Managers / Technical Managers / Senior Lab Personnel from Calibration and Testing Laboratories

Course Code:4102

Course Title: Precision Dimensional Metrology

Brief Overview:
This course aims to provide a theoretical base along with practical training on shop and laboratory methods for the measurement of dimensional and geometrical errors and surface finish. It covers various measurement methods and evaluation techniques adopted in precision measurement.

Key takeaways:
Theoretical & practical experience on different types of measuring equipment. Knowledge on sophisticated equipments such as Laser Interferometer, Co-ordinate Measuring Machine, Autocollimator, Roughness Tester etc.

Targeted Audience:
Personnel in Metrology, Inspection & Quality Assurance Depts

Course Code:4103

Course Title: Calibration of Dimensional Measuring Equipments

Brief Overview:
This course aims at providing a theoretical base along with practical training on calibration of Dimensional measuring equipments, machine tools and measuring machines. It basically covers the aspect of “WHY & HOW of calibration” which include requirements, methods and evaluation procedures for calibration of Dimensional Measuring Equipments and Machine Tools.

Key takeaways:
Theoretical and practical experience on calibration of different types of measuring equipment. Knowledge gain in calibration of sophisticated equipment such as Laser Measuring System, Co-ordinate Measuring Machine, Universal Length Measuring Machine etc.

Targeted Audience:
Personnel in Inspection, Quality Assurance, Metrology

Course Code:4104

Course Title: Uncertainty of Measurements for Dimensional Measurements

Brief Overview:
The purpose of this course is to provide broad guidelines to those who are concerned with measurements about uncertainty in measurement, estimation, and apportionment of uncertainty and interpretation of uncertainty as far as dimensional and geometrical measurements are concerned

Key takeaways:

uncertainty – concepts & definitions, Uncertainty-Sources and Measures, Evaluation of Type A and Type B standard uncertainties, expanded uncertainty in measurement, uncertainty budget and statement of uncertainty in measurement, step by step procedure for calculating the uncertainty in measurement of some dimensional measuring instruments.

Targeted Audience:
Quality Managers / Technical Managers / Senior Professionals of testing and calibration laboratories

Course Code:4105

Course Title: Introduction to CMM

Brief Overview:
The advent of Coordinate Measuring Machines has provided the capability of comprehensive measurements at one measurement station.

Key takeaways:
Introduction to Coordinate metrology, elements of CMM, Basic concepts, Probe Systems, Alignment methods, application of Laser tracker etc.,

Targeted Audience:
Personnel in Metrology, Inspection & Quality Assurance Depts.

Course Code:4106

Course Title: CMM & Machine Tool Calibration

Brief Overview:
The purpose of this course is to provide practical training on the “Calibration of CMM & Machine Tool” to enrich knowledge on calibration of machines based on various standards (ISO 10360, ISO 230-2, VDI 3441 etc

Key takeaways:
CMM performance verification guidelines and accuracy tests (like E0, MPE, R0, MPL, P FTU, MPE etc) as per ISO 10360. The other part of CNC machine Tool Calibration based on various standards (e.g. ISO 230-2, VDI 3441) and parameters requirements

Targeted Audience:
Personnel in Metrology, Inspection & Quality Assurance Depts.

Course Code:4201

Course Title: Micro and Nano Manufacturing

Brief Overview:
There is a growing demand for smaller, faster, and more efficient devices, focusing on the creation of precise components with micro features through micro- and nano-machining techniques. Miniaturization is crucial in industries like electronics, medical devices, and aerospace, where compact and lightweight designs are essential. This course offers an overview of micro and nano-machining processes, highlighting the micro components developed for various sectors and applications. Along with theoretical lectures, participants will gain practical experience with advanced, world-class facilities and learn how to inspect micro parts.

Key Takeaways:
This course provides participants with both theoretical understanding and practical skills to apply micro and nano machining techniques in real-world industrial and research applications.

Targeted Audience:
Scientists /Engineers/R&D labs / Researchers involved in micro/nano product development and micro/nano machining activities

Course Code:4202

Course Title: Advanced Laser Machining

Brief Overview:
The course is designed to disseminate cutting-edge technology and research in laser-based material processing. In today’s world, lasers offer new and innovative solutions in many manufacturing areas, especially in advanced material processing. The course's main objective is to provide exposure to practical problems and their solutions through laser-based micromachining and additive manufacturing processes in various industries.
Focussed Areas:
Micromachining, Pulsed Lasers for Machining etc.

Key Takeaways:

- Introduce the participants to the fundamental properties of laser beams as advanced materials processing and manufacturing tools.
- Provide the participants with an overview of principles involved in laser-material interactions.
- Provide exposure to practical problems and their solutions through various case studies related to laser-based advanced machining.
- Introduction and hands-on to the advanced laser machining facilities available in CMTI.

Targeted Audience:

Scientists/ Engineers & Academicians interested in Micromachining, Manufacturing, Tooling & Product Development Engineers, Material science researchers, Material & Metallurgists

Course Code:4203

Course Title: Thin Film Deposition Techniques and Characterisation Methodologies

Brief Overview:

This course provides theoretical base and practical training on thin film deposition technologies as well as characterization methodologies. Participants will gain in-depth knowledge of thin film deposition techniques from the theoretical and practical sessions. The practical sessions include sample preparation and thin film deposition using Magnetron Sputtering, Plasma Enhanced Chemical Vapor Deposition (PECVD), E-Beam Evaporation and Electroplating. The course also includes theoretical and practical sessions on the characterization methodologies, covering electrical, structural, and mechanical properties of thin films. Through practical sessions, participants gain valuable insights into the industrial applications of these cutting-edge technologies in the coatings. This comprehensive training will enhance participants knowledge base and equip them with the necessary skills for research, development, and industrial applications in the field of thin-film deposition.

Key Takeaways:

Acquire the necessary skills and knowledge to conduct research, development, and industrial applications in the field of thin-film deposition.
Gain a comprehensive understanding of the principles and mechanisms Magnetron Sputtering, Plasma-Enhanced Chemical Vapor Deposition (PECVD), E-Beam Evaporation and Electroplating techniques.
Explore the characterization methodologies for mechanical, electrical, and chemical properties of thin films.

Targeted Audience:

Scientists, Engineers, R&D professionals, Teaching professionals, Lab Technicians, Researchers, and Project Assistants, PG students.

Course Code:4204

Course Title: Advanced Signal Processing in Micro-manufacturing and Automation

Brief Overview:

Advanced Signal Processing is instrumental in transforming traditional manufacturing processes into highly efficient, precise, and intelligent systems. Recognizing the growing demand for application-specific signal processing tools in modern manufacturing, this course is designed to equip professionals with the comprehensive knowledge and practical skills needed to analyze, process, and interpret signals in the time and frequency domain within the framework of manufacturing systems and automation technologies using deep learning techniques. By bridging the disciplines of signal processing and manufacturing, the course focuses on optimizing performance, enhancing precision, and improving efficiency in automated micro-scale production systems. The tentative training schedule is as follows.

Focussed Areas:

- Role of signal processing in the future of Industry 4.0 and micro-manufacturing
- Machine learning and AI techniques for signal classification and anomaly detection
- Successful implementations of signal processing in micro-manufacturing and automation: case studies and applications

Key takeaways:

Key concepts of signal processing, applications, challenges, and future trends Use signal processing for detecting faults in machinery and manufacturing processes Leveraging deep learning techniques in advanced signal processing for automation applications

Targeted Audience:

Engineers, researchers, and practitioners aiming to innovate in high-precision manufacturing industries

Course Code:4205

Course Title: Advanced Surface Finishing and Characterization Techniques

Brief Overview:

This course aims to provide a comprehensive understanding of advanced surface finishing techniques and their applications in precision manufacturing. Participants will explore various non-conventional finishing methods such as Laser Polishing, Magneto-Abrasive/Rheological Finishing, Electrochemical Polishing, and Abrasive Flow Finishing, along with characterization study. The program

also covers with a demonstration of advanced characterization techniques at CMTI, providing exposure to cutting-edge equipment and methodologies.

Focused Areas:

- To impart knowledge of advanced surface finishing techniques.
- To explore finishing technologies and their industrial applications.
- Demonstration of Abrasive flow finishing techniques.
- To familiarize participants with advanced characterization tools at CMTI.

Key takeaways:

- In-depth knowledge of various surface finishing techniques and their working principles.
- Understanding of material behaviour and surface modifications achieved through advanced finishing.
- Practical exposure to industrial Abrasive flow finishing processes through demonstrations and lab visits.
- Networking opportunities with industry professionals, researchers, and academicians.

Targeted Audience:

- Researchers and Academicians in material sciences, mechanical engineering, and manufacturing.
- Industry Professionals in precision machining, surface finishing, and quality assurance.
- Graduate and Postgraduate Students specializing in advanced manufacturing and materials engineering.
- Engineers and technicians are interested in learning about surface treatment techniques.

Course Code:5201

Course Title: Additive Manufacturing

Brief Overview:

This training course is designed to provide an in-depth understanding of advanced Additive Manufacturing (AM) technologies, with a focus on Direct Metal Laser Sintering (DMLS), Direct Metal Deposition (DMD) and Micro stereolithography (MSL). The course covers the different AM technologies, including the principle, materials and applications. The participants can learn Design for Additive Manufacturing (DfAM), the guidelines, industry practices and case studies. The constructional features and functions of various AM machines, the integration of smart manufacturing practices as well as the operation and programming will also be covered. Additionally, the course covers essential aspects such as CAD pre-processing, slicing, process parameters, topology optimization, along with insights into post-processing techniques and the characterization of AM materials and parts. Through a combination of lectures, practical demonstrations, and site visits to characterization and post-processing facilities, participants will be equipped with the skills needed to effectively implement and manage AM processes in various industrial applications.

Focused areas / Objectives

- Different Additive Manufacturing (AM) technologies, Materials and Applications
- Metal Additive Manufacturing
- Application of AM Technologies in Engineering Industries
- AM's Impact on Product Design and Development
- Understanding AM Process Parameters and Optimization
- Insights into Material Characterization
- Exploration of Post-Processing Techniques

Key Takeaways

- Comprehensive understanding of Additive Manufacturing technologies and their specific applications in various industries such as aerospace, automotive, tooling, energy, medical and general engineering.
- Knowledge in operating and programming DMLS and DMD machines, along with the ability to generate tool paths, simulate and work with Magics and DMDCAM software.
- Insights into Topology Optimization that can be leveraged to enhance part functionality while reducing material costs.
- Knowledge of AM Process Parameters and how to tailor them to produce AM parts for industrial use.
- Understanding of Characterization for AM raw materials and parts, including how to ensure consistency and quality control throughout the AM process.
- Exposure to industry-relevant post-processing techniques for AM parts

Targeted Audience:

Practicing Engineers, Scientists, Design Engineers, Manufacturing Engineers, Industry Professionals, Faculty members and Research Students.

Course Code:6101

Course Title: Part Programming of CNC Machines

Brief Overview:

Our comprehensive CNC Part Programming Training Program is meticulously designed to equip industry professionals with the essential skills and knowledge required for efficient CNC programming and operation. This hands-on course emphasizes practical learning, enabling participants to write and execute CNC programs on both lathes and machining centres, with a focus on FANUC and SIEMENS controllers.

Course Introduction

In today's rapidly evolving manufacturing landscape, proficiency in CNC (Computer Numerical Control) programming is paramount. Our training program offers an in-depth exploration of CNC programming concepts, tailored for professionals aiming to enhance their technical capabilities. Through a blend of theoretical instruction and practical application, participants will gain a robust understanding of CNC

operations, ensuring they are well-prepared to meet industry demands.

Focussed Areas:

- Comprehensive CNC Programming: Develop a thorough understanding of programming for CNC lathes and machining centres, with an emphasis on FANUC and SIEMENS controllers.
- Hands-On Application: Engage in practical exercises that involve writing, testing, and running CNC programs directly on the machines, facilitating experiential learning.
- Controller Proficiency: Master the functionalities and programming nuances of FANUC and SIEMENS CNC controllers, enhancing versatility in various manufacturing settings.
- Customization Based on Client Needs: The course duration is five days but can be tailored to focus on specific areas of interest, ensuring alignment with organizational objectives.

Key Takeaways

- **Enhanced Programming Skills:** Participants will acquire the ability to write efficient and effective CNC programs, optimizing machining processes.
- **Operational Competence**: Gain practical experience in setting up and operating CNC machines, translating programming knowledge into real-world applications.
- **Controller Expertise**: Achieve proficiency in navigating and programming both FANUC and SIEMENS CNC controllers, broadening operational capabilities.
- **Problem-Solving Abilities**: Develop critical thinking skills to troubleshoot and resolve common issues encountered in CNC programming and operations.

Targeted Audience:

This program is ideal for:

- Shop Floor Supervisors: Individuals overseeing machining operations who seek to deepen their understanding of CNC programming to enhance supervisory effectiveness.
- Entry-Level CNC Programmers: Professionals at the beginning of their CNC programming careers aiming to build a solid foundation in programming and machine operation.
- Job Setters: Technicians responsible for setting up CNC machines who wish to expand their programming knowledge to improve setup efficiency.

Manufacturing Professionals: Both freshers and experienced personnel interested in refreshing or advancing their CNC programming skills to stay current with industry advancements

Course Code :7101

Course Title: Geometric Dimensioning and Tolerancing (GD&T)

Brief Overview:

Geometric Dimensioning and Tolerancing (GD&T) is a precise, standardized engineering language that removes uncertainties in technical drawings, ensuring the designer's intent is communicated clearly. By facilitating seamless communication between design, production, and quality teams, GD&T enables organizations to operate efficiently in a concurrent engineering environment. In today's competitive industrial landscape, the effective application of GD&T not only enhances clarity and collaboration but also reduces manufacturing and inspection costs, leading to improved operational efficiency and a stronger competitive edge. CMTI adheres to the ASME Y14.5 GD&T standard, ensuring that participants are taught in alignment with all relevant engineering principles. CMTI boasts a state-of-the-art training facility, equipped with world-class machining and measurement systems labs, making it an ideal environment for hands-on, practical GD&T training. The program is delivered by experienced scientists with extensive project work experience, ensuring that participants receive industry-relevant insights and practical knowledge

Objectives:

1. Introduction to Geometric Dimensioning and Tolerancing (GD&T)
   - Overview of GD&T
   - Definition and importance in engineering drawings
   - Purpose of GD&T in ensuring design intent
   - Fundamental Dimensioning Rules
   - Basic principles and standards for dimensioning
   - Coordinate Tolerancing & Its Shortcomings
   - Introduction to coordinate tolerancing
   - Limitations and challenges in traditional tolerancing methods
   - GD&T Terms, Symbols, Rules, and Concepts
   - Core terminology, symbols, and basic rules in GD&T

2. GD&T Symbology
   - Feature Control Frame (FCF)
   - Structure and Components of the Feature Control Frame
   - Interpretation of FCF
   - Modifiers and Symbols
   - MMC, LMC, RFS
   - Feature and Feature of Size
   - Definition of features and features of size

3. Material Conditions
   - Material Conditions: MMC, LMC, RFS
   - Maximum Material Condition (MMC)
   - Least Material Condition (LMC)

- Regardless of Feature Size (RFS)
- Virtual Condition
- Understanding virtual condition and its significance in GD&T

4. Datums and Datum Systems
   - Introduction to Datums
   - Definition and importance of datums in GD&T
   - Types of datums (primary, secondary, tertiary)
   - Restraining Degrees of Freedom with Datums
   - How datums control part geometry
   - Use of Datum Targets
   - Explanation of datum targets and their application
   - Datum Shift
   - Material conditions applied to datums and their effects
5. Form Tolerances
   - Flatness
   - Definition and application of flatness tolerance
   - Straightness
   - Explanation of straightness tolerance
   - Circularity
   - How circularity tolerance controls roundness
   - Cylindricity
   - Understanding cylindricity tolerance and its use in cylindrical parts
   - Applications of Form Tolerances
   - Practical examples and real-world applications of form tolerances

6. Orientation Tolerances
   - Angularity
   - Defining and applying angularity tolerance
   - Parallelism
   - Explanation of parallelism tolerance and its applications
   - Perpendicularity
   - Understanding perpendicularity tolerance
   - Application of Orientation Tolerances
   - Practical usage and examples in engineering designs

7. Profile Tolerances
   - Profile of a Line
   - Defining and applying profile of a line tolerance
   - Profile of a Surface
   - Understanding profile of a surface tolerance
   - Composite Profile
   - Explanation of composite profile tolerance and its applications

8. Location Tolerances
   - Position Tolerance
   - Introduction to position tolerance and its applications
   - Symmetry
   - Explanation of symmetry tolerance and its use in part alignment
   - Concentricity
   - Understanding concentricity tolerance and its applications
   - Application of Position Tolerance Feature Control Frame
   - How to apply position tolerances using FCF
   - Position Tolerance Measurement Methods
   - Measurement techniques (Functional Gage, CMM data)
   - Zero Tolerancing at MMC
   - Concept of zero tolerancing at Maximum Material Condition (MMC)

9. Composite Position Tolerance
   - Basic Concept and Characteristics
   - Understanding composite position tolerance
   - Various Interpretations of Composite Position Tolerance
   - Different methods of interpreting composite position tolerance

10. Runout Tolerances
    - Circular Runout
    - Explanation of circular runout tolerance
    - Total Runout
    - Understanding total runout tolerance and its application

11. GD&T Applications and Best Practices
    - Application of GD&T in Design
    - How GD&T is applied in real-world design scenarios

- Best Practices for GD&T Implementation
- Practical tips for effectively using GD&T in manufacturing and quality control

12. Hands-on Practical Training
- Machining and Measurement Systems Labs
- Hands-on exercises in machining and measurement systems
- Practical Application of GD&T
- Real-world case studies and problem-solving scenarios

13. Tolerance Stack up

At the end of the course, participants will be able to:
- Understand the Importance of Applying Correct GD&T on Drawings
- Recognize the significance of using proper GD&T for clarity, communication, and ensuring design intent in technical drawings.
- Master Important GD&T Terms and Definitions
- Gain familiarity with core GD&T terminology, symbols, and their meanings.
- Understand the Relationship of Geometric Characteristics and Feature Types
- Learn how geometric characteristics are related to feature types (RFS, MMC, and LMC conditions).
- Calculate bonus tolerance and apply it effectively in design and manufacturing.
- Inspect GD&T Features Using Conventional Methods, CMMs, and Functional Gauges
- Acquire skills to inspect parts with GD&T features using traditional measurement techniques, Coordinate Measuring Machines (CMM),
- and functional gauges.
- Apply GD&T Controls for New Product Development Using Case Studies
- se case studies to apply GD&T principles in real-world new
- product development scenarios.
- Practice with ASME Y14.5M Standard Codebook Gain proficiency in using the ASME Y14.5M standard codebook for practical GD&T applications.

Targeted Audience:

Design Engineers: For creating clear and accurate drawings; Manufacturing Engineers: To ensure manufacturability and adherence to design intent.

Quality Assurance Professionals: For precise measurement and inspection; Students and Fresh Graduates: To build foundational knowledge; Managers and Team Leads: To understand GD&T's importance in workflows.

Course Code:7102

Course Title: MECHATRONICS & MANUFACTURING AUTOMATION

Brief Overview:

Mechatronics is an interdisciplinary branch of engineering that integrates mechanical, electrical, electronics, computer science, and control engineering to design and develop intelligent systems. In today's rapidly evolving industrial landscape, automation, robotics, and smart manufacturing rely heavily on mechatronics principles to enhance efficiency, precision, and productivity.

With industries increasingly adopting Industry 4.0 and Smart Manufacturing, the demand for engineers skilled in sensor integration, industrial controllers, robotics, and automated systems has grown significantly. To address this need, CMTI (Central Manufacturing Technology Institute) is offering a 5-day training program on "Mechatronics – Fundamentals & Core Concepts", designed to provide engineers with hands-on experience in mechatronic system design, industrial automation, and advanced control techniques.

Focussed Areas:
- Understanding mechanical elements such as Ball screw, Guideways, Bearings, Coupling, Harmonics drive, Linear motor & High speed spindle etc
- Electrical controls - Concept of PLC, Configuration & programming
- Hydraulic & pneumatics and electrical system integration
- Understanding of Hydraulics & pneumatics
- Working with sensors, actuators, and industrial communication protocols
- Exploring testing automation and automation in manufacturing
- Machine vision based solutions
- Smart manufacturing & industry 4.0

Targeted Audience:

Mechanical Engineers/Electronics/Electrical/Computer science/Control engineers/ Manufacturing Engineers/

Students and Fresh Graduates: To build foundational knowledge.

Managers and Team Leads: To understand Mechatronics importance in workflows

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ENROLLMENT FORM

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Course code	
Title of the Training Programme	
Commencing Date	

Sl No.	**Name of the participant (in block letters)**	**Designation**	**Contact No**
1			
2			
3			
4			

Organisation Name	
GST No.	
Address (for correspondence)	
Contact person Name	
Designation	
Phone / Mob	
Email	
Fax	
Payment Details : (made through online NEFT /RTGS/IMPS)	

Enclosed Cheque / DD No._____ dated_____
For ₹ _____ drawn on (Bank)_____
in favour of ***Central Manufacturing Technology Institute,*** *Payable at* ***Bangalore.***

Date:

Seal & Signature of the sponsoring Authority

Please Mail / Fax the completed form immediately for the address mentioned above