

## **Industry 4.0 Readiness: Advanced Machining, CNC, and Quality Assurance Boot camp**

### **Overview**

The Mechanical Engineering Department, MET's Institute of Engineering, Nashik, offers a focused, hands-on internship/training program on **Industry 4.0 Readiness: Advanced Machining, CNC, and Quality Assurance Boot camp**. This **four-week (25-day)** internship is designed to equip engineering students with the critical, hands-on skills required by the modern manufacturing sector. This program is specifically structured to bridge the gap between theoretical knowledge and the practical demands of CNC machining, advanced cutting technologies, and industrial quality assurance.

### **Internship / Training Highlights and Core Module**

#### **1. Fundamentals of Cutting Science**

Gain mastery over the foundational physics and mechanics that govern material removal:

- **Tool Geometry and Mechanics of Chip Formation:** Detailed study of rake, clearance, and wedge angles and their influence on chip flow, cutting efficiency, and surface finish. In-depth understanding of shear processes, friction, and the different types of chips (\$C1\$ to \$C4\$).
- **Cutting Forces & Power:** Learn to calculate and analyze the forces acting on the tool and the necessary power input for efficient machining.
- **Thermal Management:** Analysis of heat generation and distribution and its impact on work piece integrity and tool life.
- **Tool Life Optimization:** Practical application and derivation of the Taylor Tool Life Equation ( $V T^n = C$ ) for determining economic machining speeds.

#### **2. Machining Processes and Hands-on Execution**

Participants will receive practical, hands-on training on essential machine tools:

- **Conventional Processes:** Principles and execution of Turning (facing, threading, boring), Milling (peripheral and face), Drilling, Reaming, and Boring.
- **Abrasive Machining:** Introduction to Grinding processes for high-precision finishing.
- **Workshop Sessions:** Dedicated hours in the MET workshops for practical application and tool setting.

### 3. CNC Programming and Automation (The Digital Core)

This module focuses on the essential skills for automated manufacturing:

- **CNC Fundamentals:** Mastering machine coordinate systems, axes, and controller functions.
- **G-Code & M-Code Mastery:** Intensive, hands-on training on writing, simulating, and executing CNC programs for 2-axis turning and 3-axis milling.
- **CAD/CAM Integration:** Introduction to the workflow of converting a 3D part model (CAD) into an optimized tool path (CAM) for efficient production.

### 4. Quality Assurance and Precision Metrology

Learn to measure, verify, and document precision:

- **Surface Roughness:** Definition, measurement, and control of surface texture parameters ( $R_a$ ,  $R_z$ ) as a function of machining parameters.
- **Geometric Dimensioning and Tolerancing (GD&T):** Foundational training in the language of precision—understanding tolerances, datums, and feature controls for manufacturability.
- **Metrology Practice:** Hands-on use of precision instruments like vernier calipers, micrometers, dial gauges, and an introduction to CMM (Coordinate Measuring Machine) principles.

### 5. Additive Manufacturing

- Learn Basic concept of 3D printing.
- Convert ideas → CAD → printed functional parts within the course duration.
- Exposure to **industry-relevant software** (CAD, slicing, simulation tools).
- **Hands-on experience with real 3D printers** (FDM / SLA exposure).
- Develop skills aligned with **Industry 4.0 and smart manufacturing**.

**6. Eligibility and Internship Details**

Detail	Specification
Department	Mechanical Engineering Department, MET's Institute of Engineering, Nashik
Internship Area	Mechanical Engineering Department
Duration	4 Weeks (25 days in the month of January/ February 2026 )
Working Mode	Offline
Working Hours	2 – 4 Hours per day
No. of Students	12
Eligibility	All branches of Engineering (2nd Year, 3rd Year & Final Year) students.
Pre-requisites	Not Required
Last Date to Apply	30 December 2025

**7. Expected Learning Outcomes**


- **To understand the fundamentals of cutting science**, including chip formation, cutting forces, heat generation, and tool life based on Taylor's tool life equation, and apply these principles to practical machining decisions.
- **To develop hands-on machining and CNC automation skills**, covering conventional machining operations, writing and simulating G-code and M-code, and integrating CAD models with CAM-generated toolpaths.
- **To learn quality assurance fundamentals**, including surface roughness control, basics of GD&T, and the use of precision metrology and inspection instruments.
- **To enhance hands-on skills in Additive Manufacturing**, enabling students to design, fabricate, and evaluate functional components using industry-relevant AM technologies, materials, and software for real-world engineering applications.

**8. Deliverables and Evaluation**

- Successful completion of the boot camp/ internship will earn participants a Certificate of Completion from the Mechanical Engineering Department, MET Bhujbal Knowledge City, Nashik..

  
Dr.A.S.Patil / Mr.A.D.Patil

Internship/Training/Boot camp Coordinator

  
Dr.S.D.Kalpande

H.O.D