CNC Machining Study Guide – Up Academy

I. SAFETY & SHOP PRACTICES

Source: Safety for Metal Cutting 101

- Personal Protective Equipment (PPE): Includes safety glasses, steel-toed boots, earplugs.
- Machine Guards: Fixed, moveable, and splash guards to protect the operator.
- Chip Management: Use of chip augers, air nozzles, and coolant to remove chips.
- Cutting Fluids: Coolant, cutting oil, straight oil, and synthetics – know their risks and uses.
- Fire Risks: Understand spontaneous combustion from oily rags, flammable fluids, and hot chips.

II. TOOLING & MACHINE COMPONENTS

Source: Milling Machine Components Definitions

- Milling Machine: Spindle, table, saddle, knee, quill, DRO, etc.
- Lathe Setup: Use of chuck, collet, draw tube liner, tooling installation, and offset settings.
- Important Tools: Inserts, part-off tools, threading tools, OD grooving tools, and operation checklists.

III. MATH SKILLS FOR MACHINING

Source: Decimal Lingo Worksheet, CNC Trigonometry Practice Problems

- Decimal Lingo: Examples include 0.100 = "one hundred thousandths", 0.1 = "one tenth", 0.0005 = "five ten-thousandths".
- Trigonometry: Right triangle calculations for toolpath distance, chamfers, tapers.
- Pythagorean Theorem: $A^2 + B^2 = C^2$, used in distance calculations.

IV. CNC PROGRAMMING ESSENTIALS

Source: G/M Code Sheets, 9-Lines Start Here, G98-G99

- G-Codes: G00 (Rapid), G01 (Linear cut), G02/G03 (Circular interpolation), G17-G19 (Plane selection), G81-G83 (Drilling cycles).
- M-Codes: M00/M01 (Program stop), M03/M04 (Spindle on), M06 (Tool change), M08/M09 (Coolant control), M30 (End program).
- Canned Cycles: G81-G83; Clearance Planes: G98 returns to R plane, G99 returns to previous Z.

V. BLUEPRINT READING & PRINT INTERPRETATION

Source: Blueprint Reading 131, Engineering Drawing 132

- Types of Views: Orthographic, Auxiliary, Section (full/half/offset/removed), Isometric.
- Line Types: Object, Hidden, Center, Dimension, Extension, Section, Break, Phantom.
- Projection Systems: Third-angle (U.S.), First-angle (Europe).
- Tolerances: General blocks include .030, .010, .005, Angles ±1°.

VI. GD&T and PART INSPECTION

Source: GD&T Applications 312, Inspecting a Prismatic Part 321

- Tolerance Types: Form (Straightness, Flatness), Orientation (Angularity, Parallelism, Perpendicularity), Profile (Line/Surface), Runout (Circular/Total), Position.
- Material Conditions: MMC, LMC, RFS, Virtual Condition.
- Gaging Tools: Calipers, Micrometers, Dial Indicators, CMMs, Functional and Go/No-Go gages.

VII. VOCABULARY WORDS

Source: All SME Class Vocabulary PDFs

Each student should review vocabulary from the following topics:

- Inspecting a Prismatic Part 321
- Basic Cutting Theory 201
- Basics of tolerance 121
- Manual Mill setup 221

- Manual Mill Basics 201
- Blueprint Reading 131
- Types of Prints & Engineering Drawings 132
- Safety for Metal Cutting 101
- GD&T Applications 312