Advanced Manufacturing Standards

Combining the key elements from both sets of standards, we can create a comprehensive curriculum that addresses foundational manufacturing principles while integrating advanced technologies in automation and robotics. Here's a proposed structure for an advanced manufacturing program:

Standard 1.0: Examine the Impact of New Technologies on Manufacturing, Automation, and Robotics

1.1 Describe the principles, processes, and practices of AI (artificial intelligence), ML (machine learning), and RPA (robotic process automation) 1.2 Discuss how the application of AI, ML, and RPA have changed existing business practices (e.g., enhanced efficiency, increased work performance, reduced human error, simplified interactions, speedier processes, improved customer experience) 1.3 Give examples of how AI, ML, and RPA are used in services, manufacturing, agriculture, and healthcare 1.4 Relate the Three Laws of Robotics (Asimov's Laws) to future technology applications 1.5 Discuss ethical challenges associated with AI, ML, and RPA (e.g., privacy, data inaccuracies, future loss of jobs, how machines affect human behavior and interaction)

Equipment Alignment- Festo MecLab & Universal Robots

Certifications- NC3 Introduction to Mechatroncis, NC3 Introduction to Industry 4.0, Universal Robots Certification

Standard 2.0: Perform Electrical and Electronic Tasks

2.1 Measure and determine voltage, current, resistance, and power in AC and DC circuits (e.g., oscilloscope, volt/ohm meter) 2.2 Troubleshoot voltage, current, and power in AC and DC circuits (e.g., fuse, continuity) 2.3 Identify and troubleshoot components and connections 2.4 Read electrical drawings (e.g., simple starter circuits, PLC output) 2.5 Explain the role of electronic devices in automation and robotics

Equipment Alignment- Festo AC/DC Trainer & Festo FACET Electronics

Certifications- NC3 Fundamentals of Electricity (Level 1)

Standard 3.0: Analyze Hydraulic and Pneumatic Systems

3.1 Describe the relevance of material properties to robotics (e.g., inertia, velocity, mass, density, strength) 3.2 Examine the performance of hydraulic circuits 3.3 Examine the

performance of pneumatic circuits 3.4 Troubleshoot hydraulic and pneumatic circuits (e.g., flow controls, valve functionality, pressure sensors) 3.5 Describe the fundamentals of vacuum technology

Equipment Alignment- Festo Hydraulics & Pneumatics Training Systems (Fluid Power) with Electro

Certifications- NC3 Fundamentals & Applied Fluid Power (Level 1 & 2)

Standard 4.0: Analyze Programmable Logic Controller (PLC) Systems

4.1 Explain PLC functionality (e.g., relate schematics to PLC inputs/outputs, program flow) 4.2 Interpret ladder logic and other commonly used industrial languages 4.3 Develop a flowchart that identifies and solves the automation problem 4.4 Upload/download a logic program into a PLC 4.5 Troubleshoot input/output modules (AC and DC)

Equipment Alignment- Festo PLC & Advanced PLC Training Systems with Applications

Certifications- NC3 Fundamentals & Applied PLC's (Level 1 & 2)

Standard 5.0: Describe the Operation and Use of Various Forms of Electrical Motors

5.1 Explain the "safety by design" concept to ensure operator and workspace safety 5.2 Explain the operation and use of DC motors in automation controls 5.3 Explain the operation and use of stepper motors in automation scenarios 5.4 Explain the operation and primary use of AC motors in automation assemblies 5.5 Explain the operation, use, and advantages of brushless motors in automation and robotics 5.6 Describe how servos are used in automation and robotics (e.g., robot arms, legs, and steering)

Equipment Alignment- Festo Industrial Motor Controls

Certifications- NC3 Applied Motor Controls (Level 2)

Standard 6.0: Perform Mechanical Systems Linkages Tasks

6.1 Explain gear reduction and install a belt or chain drive 6.2 Explain gear ratio and install a gear train 6.3 Compute mechanical advantage of a belt or chain drive 6.4 Compute mechanical advantage of a gear train

Equipment Alignment- Festo Mechanical Training System

Certifications- NC3 Fundamentals & Applied Mechanical Systems (Level 1 & 2)

Standard 7.0: Identify Industrial Robot Types and the Tasks They Perform

8.1 Identify robot types and degrees of freedom (e.g., SCARA, articulated, cartesian, delta) 8.2 Measure robotic performance against specified criteria 8.3 Interface a robot to real or simulated external equipment 8.4 Simulate a solution

Equipment Alignment- Universal Robots, Festo Fanuc MPS Cells, KUKA Ready2Educate Cells & Festo MPS with Industry 4.0

Certifications- NC3 Fundamentals of Robotics (Level 1) & KUKA CORE Certification

Standard 8.0: Examine Data Communication Methodologies

9.1 Select data communication protocols and associated connectors 9.2 Identify tradeoffs among wired and wireless data communication protocols 9.3 Explain IoT (Internet of Things) and IIoT (Industrial Internet of Things)

Equipment Alignment- Festo Modular Production System (MPS) with Industry 4.0

Certifications- NC3 Advanced Industry 4.0 & Human Machine Interface (HMI) (Level 3)

Standard 9.0: Apply Sensor Solutions

10.1 Select sensors for use in a feedback control loop 10.2 Construct and operate a system with a feedback control loop 10.3 Calibrate sensors 10.4 Gather and statistically analyze performance data on a control loop 10.5 Explain analog to digital and digital to analog converters

Equipment Alignment- Festo Sensors & Smart Sensors Kits, Festo MecLab & Festo Skills Conveyors

Certifications- NC3 Fundamentals of Sensors (Level 1), NC3 Applied Principles of Smart Sensors

Standard 10.0: Describe Common Manufacturing Processes in Automation

11.1 Describe machining processes (e.g., traditional machining, CNC) 11.2 Describe basic material properties used in manufacturing processes (e.g., aluminum, steel, titanium) 11.3 Explain the impact of 3D printing on rapid prototyping 11.4 Explain additive manufacturing versus subtractive manufacturing 11.5 Describe basic fabrication principles (e.g., laser, sheet metal, welding, cutting) 11.6 Describe material handling (e.g., conveyors, bowl feeders, AGV)

Equipment Alignment- ROOTS EDU Cleanroom & Festo Metrology ***(Add 3D Printers and CNC Machines***)

Certifications- ROOTS EDU Cleanroom Certification- Semiconductor and Automation Technology Certification (SAT)

Standard 11.0: Develop Robotics Application Systems

12.1 Describe robotics operating systems (e.g., ROS, Linux) 12.2 Identify a problem and develop a flowchart for software development (e.g., Boolean logic, ladder) 12.3 Identify peripheral hardware required to complete the task (e.g., vision systems, 3D scanners, end-of-arm tools, force sensing) 12.4 Develop or reuse software components (e.g., modular software design) 12.5 Use software tools to develop a robotics application 12.6 Use a simulation to develop and validate a design for a robotics problem 12.7 Use a test-driven development approach 12.8 Demonstrate a methodical approach to process development 12.9 Describe integration technologies (e.g., CNC, AI, RPA, ML) 12.10 Describe robotics project constraints (e.g., timeline, budget, environment, skill level)

Equipment Alignment- Universal Robots, Festo Fanuc MPS Cells, KUKA Ready2Educate Cells & Festo MPS with Industry 4.0

Certifications- NC3 Applied Robotics (Level 2), NC3 Advanced Robotics (Level 3) & NC3 Smart Maintenance (Level 3)

Standard 12.0: Demonstrate Safe and Proper Use of Electronic and Other Laboratory Equipment, Tools, and Materials

13.1 Explain and apply proper ground requirements 13.2 Specify safety conditions when working with automation and robotics (e.g., arc flash, high voltage, pneumatics, hydraulics, stored energy) 13.3 Identify and properly use common electrical and electronics hand tools 13.4 Follow laboratory safety rules and procedures 13.5 Describe the concept of “fail safe” and how such components are integrated into robotic systems 13.6 Explain modern safety hardware and circuits (e.g., light curtains, safety fences, safety relays)