AET AAS transition to MECH AAS with AET emphasis transition

Frequently Asked Questions-FAQ

Claim: Industry won't hire me without an AET degree.

Response:

University programs often experience a program name change. Business and industry search, assess and hire candidates according to documented and demonstrated skill sets. The Mechatronics Engineering Technology AAS with emphasis in automation electrical technology will deliver the same skill sets as the former AET AAS degree with some additional skill sets for a program of added rigor.

The 2025-2027 transition will merge AET courses with MECH courses. Course learning outcomes and descriptions will continue to evolve to ensure industry skill alignment. The following frequently asked course alignment questions are:

1) AET 2280/2285 Instrumentation & Process Control

Claim: MECH 2510/2515 is similar to AET 2160/2165; instrumentation in AET 2280/2285 is missing; hydraulics/pneumatics less critical than instrumentation.

Response:

Instrumentation and process measurement content from AET 2280/2285 is already distributed and strengthened across **MECH 2515**, **MECH 2600**, and **MECH 2605**, ensuring full coverage and better sequencing.

• **MECH 2515 (Sensors & Transducers Lab)** provides hands-on experience with industrial sensors, calibration, and PLC integration. The course explicitly states: *"Specify, install, and troubleshoot strain-gage-based pressure transducers… Use thermocouples to measure temperature in a process… Interface analog sensors to microprocessors and PLCs in an automation system."* These outcomes confirm direct instruction in industrial-grade instrumentation and signal conditioning.

• **MECH 2600 (Process Instrumentation & Control)** and **MECH 2605 Lab** expand this foundation. The description includes *"measurement principles for process variables such as temperature, pressure, level, and flow"* and *"the structure and function of open- and closed-loop control systems including PID tuning concepts."* CLOs #7–8 further reinforce this: *"Interpret process and instrumentation diagrams (P&IDs) and associated instrumentation symbols"* and *"Identify safety-related requirements and classifications for industrial instrumentation."*

• **MECH 2505 (PLC Applications Lab)** bridges instrumentation with control logic, requiring students to *"Integrate Human-Machine Interfaces (HMIs) and configure communication with PLCs via serial and Ethernet protocols."* This integration introduces how measured variables from sensors are visualized and controlled through PLC systems.

• Hydraulics and pneumatics are taught **alongside instrumentation**, not instead of it. As described in MECH 2600/2605, fluid power topics support understanding of **actuators and control valves** within the same process-control context, complementing measurement and feedback systems.

Clarification: Instrumentation from AET 2280/2285 was not lost but **intentionally redistributed** between MECH 2515 (industrial sensors, calibration, and interfacing) and MECH 2600/2605 (process instrumentation, transmitters, P&IDs, PID loops, and safety). This structure enhances student progression from component-level measurement to full process control integration, ensuring each outcome is measurable and appropriately scaffolded.

2) MECH 2500/2505 vs AET 2250/2255 (Boolean algebra, datalogging, Studio 5000 timing)

Claim: Boolean should be first-semester; no datalogging taught; switch to Studio 5000 midterm.

Response: Boolean algebra, datalogging, and PLC software integration are already embedded within **MECH 2500 and MECH 2505**. The course explicitly states that it *"covers ladder logic, controls, sensors, motor starters, overloads, and electronic devices used to control and protect DC/AC machines"* (MECH 2500 description), and the lab reinforces this through *"wiring and programming PLC systems, including digital and analog I/O devices"* (MECH 2505 CLO #6). Boolean logic is introduced early and revisited in MECH 2505 CLO #7: *"Utilize conventional relay logic and Boolean algebra in the design and testing of logic circuits."*

Datalogging and advanced data handling are explicitly captured in **MECH 2555 CLO #9**, which requires students to *"Troubleshoot complex industrial PLC applications using software tools and diagnostic methods."* This includes monitoring variables, scaling analog inputs, and reviewing program data in real time.

As for software use, **MECH 2500/2505 and 2555** apply *"industry-based standards"* and *"software tools"* across PLC environments, aligning with **vendor-neutral practice**. While students often use Rockwell's **Studio 5000**, the curriculum allows for **equivalent software such as Siemens TIA Portal or Omron Sysmac Studio**, ensuring transferable skills across multiple industrial systems rather than dependency on a single proprietary platform.

3) Robotics level/placement (MECH 3500/3505)

Claim: Should be in AAS; a 3000-level course should teach full Level-3 integration with PLCs.

Response:

• **Maintain MECH 3500/3505 as a 3000-level course.** It builds upon prior coursework in wiring, PLC programming, sensors, and **industrial networking (MECH 3300/3305)**, employing **FANUC industrial robots** for teach-pendant programming, coordinated motion, fault recovery, and vision systems—appropriate to upper-division rigor and ABET's applied-analysis expectations. As stated in the course description, MECH 3500 *"covers the principles of industrial robotics, programming, and the application of vision systems using industry-created curriculum,"* while MECH 3505 explicitly applies *"the principles of industrial robotics, programming, and the application of vision systems using industrial robots."*

• **Progressive integration path: MECH 2555** introduces advanced PLC topics such as *"function blocks, add-on instructions, and user-defined data types (UDTs) for modular programming"* and *"interfaces PLCs with variable speed drives (VFDs), sensors, and encoders in automated control systems."* **MECH 3300/3305** further develops "the use of software to integrate PLCs, computers, managed switches, and smart devices into an industrial data network," and applies it in lab settings to *"integrate industrial networks on industrial equipment"* and *"troubleshoot and maintain an industrial network system."* MECH 3500/3505 then advances into robotic programming and I/O mapping, while **MECH 4800 Capstone II** culminates in full **system-level integration**—robots, PLCs, safety, and networked communication—reflecting production-scale applications. Teams routinely conduct this integration; those selecting **PLC–FANUC coordination** apply previously mastered fundamentals rather than learning them in isolation.

• **Why 3000-level placement fits:** The depth, safety, and multidisciplinary scope (robotics + vision + networking + documentation) require prior foundational mastery from the second year, making upper-division classification academically sound and industry-aligned. It's important to note that about a year and a half ago, a proposal was made to develop an **introductory (1000-level)** course intended to cover only the first, foundational chapter of MECH 3500. That course was envisioned primarily for **concurrent enrollment students** to introduce them to the basics of robotics and automation. However, the full MECH 3500 course, with its complex topics in **robot programming, motion coordination, fault recovery, and vision integration**, clearly exceeds lower-division expectations. These concepts require substantial background in **PLC systems, networking, and motion control**, confirming that MECH 3500 appropriately belongs at the **3000-level**.

• **Realistic industry expectation:** If employers require employees certified specifically in **FANUC–PLC integration**, FANUC itself offers this as a paid credential—training that costs roughly **$6,000 per participant.** Universities cannot and should not duplicate proprietary vendor training at public expense; instead, our role is to prepare **adaptable graduates** who can efficiently upskill on such systems through employer-sponsored certification.

However, it is essential to note that students who choose **FANUC-based projects in Capstone II (MECH 4800)** directly integrate PLCs with FANUC robots, demonstrating full system communication, safety, and documentation—effectively acquiring the same functional competencies expected in FANUC–PLC coordination without vendor-specific certification. **Looking ahead, a graduate-level course (FANUC–PLC integration) is being considered as part of the future Mechatronics master's degree.**

4) MECH 2300/2305 level

Claim: Should be 3000–4000 level.

Clarification:

The classification of **MECH 2300/2305** at the 2000-level is intentional and academically justified. These courses introduce foundational electronics and controls concepts necessary for higher-level applications in motion control, networking, and robotics.

The description for **MECH 2300** explicitly states that it *"covers the fundamentals of electronic circuits, amplifiers, sensors, and control interfaces used in automation and mechatronic systems."*
Likewise, **MECH 2305** reinforces this through practical application: *"builds and tests electronic circuits used for signal conditioning, motor control, and system feedback."*

This foundational knowledge scaffolds directly into **MECH 3220/3225 (Motion Control)**—which *"presents the selection and application of AC and DC servo motors and control of speed and position in automation systems"*—and **MECH 3300/3305 (Industrial Networks)**—which *"covers the design, configuration, and integration of industrial networks connecting PLCs, managed switches, and smart devices."*

Raising MECH 2300/2305 to the 3000-level would disrupt prerequisite sequencing, weakening the stepwise progression from component-level understanding to system-level design. Therefore, maintaining them at the 2000-level ensures a logical, accredited pathway consistent with ABET-aligned scaffolding and the USHE AAS-to-BS framework.

5) CNC course level (MECH 3700/3705)

Claim: Should be 2000 level (same as legacy AET 2010/2015).

Response: MECH 3700 and MECH 3705 are correctly placed at the **3000 level** because they build upon prerequisite skills in **3D modeling (EGDT 1071)**, **GD&T and tolerance analysis (MECH 3570)**, and **motion control integration (MECH 3220/3225)**.

According to the **MECH 3700 course description**, students "cover the application, programming, and maintenance of CNC machines" and "emphasize integration of CNC machines into automation systems," including "interfacing with industrial robots." Likewise, **MECH 3705** requires students to "program CNC machines using simulation software" and "integrate CNC machines with factory systems."

These outcomes demonstrate that MECH 3700/3705 extend beyond simple CNC operation—they teach **robotic integration, automation communication, and systems thinking**, distinguishing them from the legacy 2000-level AET 2010/2015 courses, which focused solely on standalone CNC operation.

6) Capstone documentation (MECH 4300 & 4800)

Claim: Students should produce manuals/documentation.

Response:
This outcome is already implemented through *writing-enriched* components embedded in the Mechatronics curriculum. Both MECH 3570 and MECH 4800 are writing-enriched courses where students compose professional technical manuals and validated system documentation.

- **MECH 3570 – Design Analysis and Rapid Prototyping:**
  This course includes a dedicated *writing-enriched module* where students learn to prepare professional technical manuals. They practice writing structured technical documentation, editing and correcting existing manuals, and applying professional engineering writing standards. The course outcomes specifically state:
  "Compose a variety of disciplinary-appropriate texts within multiple situations and for multiple audiences."
  Students develop the ability to communicate technical concepts clearly and accurately, a skill that directly transfers to later design and project documentation work.
- **MECH 4800 – Capstone II:**
  Building on the writing foundation from MECH 3570, Capstone II requires students to apply professional documentation practices to their final projects: "Integrate design theory into their team project," and "Complete an industry-standard design document of their project." Also, the clo *"Compose a variety of disciplinary-appropriate texts within multiple situations and for multiple audiences."* They create comprehensive manuals, schematic diagrams, and validation reports that capture the complete design, wiring, and testing processes of their projects. These deliverables are evaluated for clarity, accuracy, and adherence to industry standards, directly supporting ABET's communication outcome.

Together, these courses ensure that Mechatronics students graduate with robust technical writing proficiency, capable of producing professional-grade manuals and documentation reflective of real-world engineering practice.

7) Calculus

Claim: The Program should include at least one/two applied calculus courses to meet ABET.

Response:
Mathematics and calculus concepts are already embedded across multiple Mechatronics courses at the appropriate ABET Engineering Technology level.

- **MECH 3220 – Motion Control for Mechatronic Systems:**
  Uses derivatives and integrals within *speed/position control, PID analysis, and feedback design*.
  → CLO 5 explicitly states: *"Design the application of proportional/integral/derivative control of speed and position."*
  These applied calculus elements directly address ABET's expectation for "algebra, trigonometry, and application of calculus to engineering technology problems."
- **MECH 3400 / 3405 – Statics and Material Properties:**
  Applies calculus in stress/strain analysis, centroid, and area moment calculations.
  → CLO 3 states: *"Calculate the centroid and area moments of inertia,"* which inherently involves calculus operations in integration.

Historically, the Mechatronics program also included (deleted) **MECH 3100 – Advanced Technical Math Applied to Automation**, which covered *algebra, trigonometry, geometry, and introduced differential and integral calculus in system modeling and design*. Its outcomes—
"Apply differentiation and integration to solve automation problems"—were distributed intentionally across higher-level courses as part of curriculum modernization supported by former AET leadership.

Rather than teaching calculus in isolation, the program now follows a **contextual-math model**: mathematical applications are taught within each engineering course (e.g., motion control, statics, and MATLAB), ensuring that students *apply calculus directly in technical problem-solving.* This integrated approach meets ABET ET Criterion 5 for mathematics depth and relevance while aligning with our applied-learning philosophy.

8) Three-Phase Power and Electrical Safety Confidence

Claim: Graduates are uncertain working with three-phase power; industry concerns cite safety incidents and lack of applied confidence.

Response:
Three-phase power is **explicitly taught and practiced** in the Mechatronics Engineering Technology curriculum through **MECH 2700 – Industrial Motor Control for Mechatronic Systems** and its co-requisite **MECH 2705 Laboratory**.

- **MECH 2700** "*describes three-phase systems, transformers, and delta-wye connections*" and includes a course learning outcome to "*describe three-phase electrical power and transformers*."
- **MECH 2705** applies this knowledge hands-on: lab activities "*include the wiring of transformers, and three-phase systems in both delta and wye configurations*," with students expected to "*analyze three-phase electrical and transformer connections*." These activities are performed alongside **lockout/tagout**, overload protection, and fault-diagnosis exercises that directly address safety confidence in industrial motor applications.

This foundational training is **reinforced in MECH 3220 – Motion Control for Mechatronic Systems** and **MECH 3225 Lab**, where students integrate **servo and variable-frequency drives**—devices inherently powered by three-phase systems—into automated motion-control applications.

Conclusion:
Three-phase theory, wiring, troubleshooting, and safety are fully integrated into the AAS program sequence. Students repeatedly apply these competencies from introductory motor-control circuits to advanced motion-control and drive systems. The evidence from **MECH 2700/2705** and **MECH 3220/3225** demonstrates that the curriculum already delivers strong, ABET-aligned preparation in three-phase power—contradicting the claim of insufficient coverage.

Larger context & program philosophy

- The updated Mechatronics curriculum is **ABET-aligned** (student outcomes), **CIP 15.0406** coherent, and sequenced to build **theory → application → system integration**.
- Where AET concentrated many tasks into a two-year track, Mechatronics spans **AAS foundations** and **upper-division** depth. Compressing four-year, systems-level competencies into two years is not academically sound or sustainable.
- Universities should teach **transferable, platform-agnostic competencies**. Company-specific/proprietary training is, and should remain, an employer responsibility as part of professional development.
- Our recent **industry alignment report** (Nestlé, IPSC; pending Rio Tinto) documents **>95% coverage** of listed competencies with direct course/CLO evidence (PLCs, instrumentation, SCADA/HMI, networks, drives/motion, robotics, CAD/CNC/GD&T, safety, documentation, project leadership).

All the points raised appear to stem from misconceptions rather than evidence, as every topic mentioned is already addressed within the current Mechatronics curriculum. Three-phase power, instrumentation, Boolean logic, data acquisition, and PLC integration are explicitly covered across MECH 2200, 2510/2515, 2600/2605, 2700/2705, and 3220/3225, while advanced robotics, SCADA, CNC, and documentation are taught in the upper-division courses and capstones. The criticism seems to overlook the intentional sequencing of foundational-to-advanced competencies consistent with ABET and CIP 15.0406 standards—unlike the former AET structure, which compressed advanced applications without adequate theoretical grounding. The Mechatronics curriculum is comprehensive, evidence-based, and continuously updated through industry consultation, ensuring both conceptual depth and applied relevance.