2026-2027 COURSE SYLLABUS

ADVANCED MANUFACTURING

AUTOMATE • INTEGRATE • OPTIMIZE • MANUFACTURE

High School | Full-Year Advanced Manufacturing Course

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Academy of Advanced Aerospace Engineering

CLASSROOMS	COURSE HUB	EMAIL
D101, D102, D103	**LockwoodSTEM.org**	**jlockwood@cornerstonecharter.com**

Course Description

Advanced Manufacturing is a full-year, hands-on course focused on Industry 4.0, robotics, automation, digital systems, and computer-aided manufacturing. Students build and operate a VEX CTE Workcell, program a 6-axis robotic arm, integrate sensors and pneumatics, and use digital twins and simulation to test manufacturing systems.

The course emphasizes safe systems integration and evidence-based improvement. Students create automated workflows, analyze productivity and quality data, compare virtual and physical results, and complete a full CAD/CAM/CNC workflow using Fusion and classroom CNC mills. The course concludes with the design, machining, inspection, and technical review of a non-flight-critical aerospace component prototype.

Course Learning Outcomes

Students will develop skills across four connected areas of advanced manufacturing practice.

Robotics and Workcell Automation

- Assemble, inspect, and safely operate a VEX CTE Workcell and 6-axis robotic arm.
- Program movement and integrate conveyors, sensors, pneumatics, machine vision, and device communication.

Digital Systems and Virtual Integration

- Develop and analyze digital twins, virtual workcells, kinematics, simulations, and offline programs.
- Use virtual evidence to improve safety, robot selection, motion, layout, timing, and collision prevention.

Manufacturing Systems and Optimization

- Analyze workflow, material handling, productivity, quality, predictive maintenance, and process performance.
- Plan manufacturing processes, select stock and tooling, and use production data to improve quality, efficiency, and repeatability.

CNC Manufacturing and Professional Practice

- Create manufacturable aerospace components using Fusion CAD/CAM, verified G&M code, and classroom CNC mills.
- Document code, setups, testing, and inspection; work safely, collaborate professionally, and defend decisions with evidence.

COURSE SEQUENCE

Units of Study

ADM

START	Course Orientation and Workcell Readiness	Course introduction, engineering documentation, safety, PPE, team roles, VEX CTE Workcell construction, component inventory, wiring, inspection, calibration, and readiness checks.
1	Introduction to Industry 4.0	Smart manufacturing, assembly lines, robotic-arm motion, pick-and-place programming, path planning, absolute and relative movement, material handling, palletizing, stacking, packaging, and shipping workflows.
2	Advanced Automation in Manufacturing	Industrial workcells, safety zones, sensors, color sorting, conditionals, loops, conveyors, pneumatics, machine vision, handshaking, predictive maintenance, productivity, optimization, and coordinated movement.
3	Digital Systems and Virtual Integration	Digital twins, virtual manufacturing environments, kinematics, robot selection, simulation, collision prevention, conveyor flow, motion control, offline programming, circuit assembly, and factory-flow analysis.
4	Aerospace CNC Manufacturing	Manufacturing systems, aerospace component analysis, design for manufacturability, manufacturing calculations, CNC mill anatomy, G&M code, Fusion CAD/CAM, simulation, post-processing, machining, dimensional inspection, and fit testing.

Major Course Projects

01 VEX CTE Workcell Construction and Readiness	02 Programmed Robotic Motion and Decreasing Spirals
03 Pack and Ship Challenge	04 Automated Sorting and Coordinated Movement Challenges
05 Digital Twin and Factory in Motion Challenge	06 Aerospace Toolpath Coding Challenge
07 Aerospace Component CNC Manufacturing Challenge	

ASSESSMENT AND GRADING

How Progress Is Measured

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Grading System

Grades are calculated using a total-points system. A student's course grade is determined by dividing the total number of points earned by the total number of points available. The school grading scale will be used to convert the resulting percentage into a letter grade.

How the Grade Is Calculated

Points earned divided by points available equals the course percentage. Assignment point values reflect the scope, complexity, and evidence required.

What May Be Graded

- Workcell, robotics, simulation, CAD/CAM, CNC, and aerospace manufacturing projects
- Code, flowcharts, layouts, process models, G&M code, and machine programs
- Engineering notebook and technical documentation
- Trials, cycle time, quality, productivity, inspection, and data analysis
- Skill checks, quizzes, unit assessments, and equipment certifications
- Presentations, design reviews, reflections, and portfolios
- Individual contributions to team manufacturing work

Point values may vary slightly from one assignment to the next, but below you will find the general point structure for various assignment types.

Evidence Type	Typical Range	Examples
Daily readiness or exit check	5 points	Course procedures, progress checks, and short reflections.
Daily lesson evidence	10 points	Short analyses, notebook entries, interactive checks, and focused practice.
Technical lesson deliverable	15 points	Code, workcell diagrams, sensor or simulation evidence, process maps, and documented manufacturing work.
Extended two-day deliverable	20-25 points total	Day 1 progress checkpoint plus completed Day 2 evidence.
Project checkpoint or skill check	20 points	Focused programming, automation, data, safety, or systems checkpoint.
Unit performance assessment	50 points	Comprehensive written, programming-analysis, system-analysis, or performance assessment.
Presentation or design review	25-40 points	Rubric-scored communication, evidence, and design defense.

Extra Credit

ENGINEERING CHALLENGES ONLY

Extra-credit opportunities are limited to optional Engineering Challenges. Each unit will include approximately 3-5 challenges, and each successfully completed challenge is worth 10 extra-credit points. Challenges must meet all stated requirements, be submitted by the deadline, and represent the student's own work.

Late Work, Revisions, and Retakes

- Late work may be submitted until the end of the corresponding unit.
- Students may revise eligible design work after receiving feedback. Revised work must demonstrate meaningful improvement rather than simple resubmission.
- Skill checks, unit assessments, and equipment certifications may be retaken after the student completes additional preparation or corrective work.
- Major projects may include required checkpoints that must be completed before a student is permitted to fabricate, test, or advance to the next stage.
- Work submitted after a unit closes may require an approved exception.

MATERIALS AND DOCUMENTATION

What Students Need

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Required Materials

• Pencils and erasers	• Pens
• Colored pencils	• School-issued computer and charger
• A wired or wireless (not Bluetooth) computer mouse	• Headphones

Optional Materials

Personal safety glasses and digital calipers are recommended for students who plan to continue in engineering or manufacturing, but neither item is required.

SAFETY GLASSES

Safety glasses are provided for all students. Personal safety glasses may be used if they meet classroom standards. Students who wear prescription eyeglasses must still wear safety glasses over them because regular eyeglasses may not provide adequate impact and side protection.

Digital Calipers

Classroom calipers are available for all students. A personal set, typically available for about $10, may be helpful for home measurement practice or future engineering and manufacturing courses.

Engineering Notebook

For this course, students will keep a digital engineering notebook in Google Docs. At the start of the school year students will be provided with a template to setup this notebook. As we work through material in the course, we will go over setup of various sections in the engineering notebook. The notebook may be graded at any time without warning, so notebooks should be kept up to date at all times.

SAFETY AND DAILY PRACTICE

Safe Work Is Professional Work

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FabLab Safety

Safety is a condition of participation in all robotics, workcell, pneumatic, electrical, fabrication, programming, prototyping, and laboratory activities. Students must complete required safety instruction and equipment certifications before operating the VEX CTE Workcell, robotic arm, CNC mills, tools, machines, or specialized equipment.

- Wear required personal protective equipment whenever directed.
- Use only the tools, machines, robotic systems, materials, programs, CAM setups, post processors, speeds, feeds, and settings approved by the instructor.
- Inspect the work area, equipment, stock, tooling, and workholding before use and immediately report damage, injuries, spills, or unsafe conditions.
- Keep hands, hair, jewelry, loose clothing, cords, and personal items clear of moving equipment, conveyors, pneumatic components, cutting tools, and the robot work envelope.
- Follow all startup, shutdown, ventilation, cleanup, chip-control, and material-handling procedures.
- Never bypass guards, interlocks, emergency stops, safety zones, speed limits, supervision requirements, or other safety systems.
- Horseplay, distracting others during equipment use, and unauthorized experimentation are prohibited.
- Unsafe behavior may result in removal from an activity and temporary or permanent loss of equipment privileges.

STOP-WORK RESPONSIBILITY

Every student has the responsibility to stop and ask for help whenever a tool, material, setup, instruction, or situation appears unsafe or unclear.

Daily Classroom Expectations

- Arrive prepared with the required computer, charger, mouse, headphones, and course materials.
- Begin the posted entry task and review the daily agenda without waiting for individual reminders.
- Use class time productively and remain engaged in assigned engineering work.
- Treat classmates, ideas, equipment, projects, and shared workspaces with respect.
- Return tools and materials to their assigned locations and leave the work area cleaner than it was found.
- Follow digital citizenship expectations when using school devices, cloud storage, VEXcode, simulation and digital-twin software, code, production data, and online resources.
- Ask questions, seek feedback, and communicate problems early.

Attendance and Missed Work

Because many course activities involve demonstrations, team decisions, shared workcells, robotic systems, programming, simulation, fabrication, testing, or production-data collection, regular attendance is important. Students who are absent are responsible for checking Google Classroom, reviewing posted resources, and communicating with the instructor about missed work. Some workcell, programming, testing, or presentation activities may require an alternate assignment or a scheduled make-up opportunity.

COLLABORATION AND INTEGRITY

Own Your Work

ADM

Collaboration and Individual Accountability

Engineering is collaborative, and students will frequently work in teams. Teamwork does not remove individual responsibility. Each student is expected to:

Individual Responsibility

- Maintain an individual engineering notebook and understand the team's program, workcell layout, digital model, process, data, and safety plan.
- Complete assigned responsibilities and contribute to planning, assembly, programming, simulation, operation, testing, data analysis, documentation, and cleanup.
- Identify individual contributions during presentations, reflections, and project reviews.

Professional Teamwork

- Communicate respectfully, listen to alternative ideas, and resolve disagreements using evidence.
- Ask for help when a team member is unable or unwilling to participate safely or productively.
- Support the team without completing another student's individual responsibilities.

Artificial Intelligence

Approved artificial intelligence tools may support learning, but they may not replace the student's engineering thinking. Unless a specific assignment states otherwise, the following expectations apply:

AI May Support

- Brainstorming and generating questions
- Receiving feedback
- Troubleshooting code, simulations, CAD/CAM setups, data analysis, process maps, or manufacturing workflows
- Improving organization and clarity
- Exploring possible approaches

AI May Not Replace

- The student's own engineering thinking
- Work the student cannot explain or defend
- Research, code, CAD/CAM files, machine programs, production data, testing evidence, or notebook entries
- Assessments when AI use is prohibited
- Accurate disclosure of meaningful AI assistance

THE EXPLANATION TEST

A student must be able to explain, defend, revise, and safely apply anything submitted with AI assistance. Students remain responsible for accuracy, safety, originality, and suitability.

Academic Integrity

All submitted work must accurately represent the student's own knowledge and contributions. Copying code, robot programs, digital-twin files, CAD/CAM files, workcell layouts, process maps, calculations, reports, notebook entries, G&M code, CNC setup records, production data, inspection results, or technical documentation without permission and appropriate attribution is not acceptable. Collaboration is encouraged when assigned, but collaboration does not mean submitting identical individual work. Violations of the Cornerstone Charter Academy policies on academic integrity may result in a zero on the assignment or further administrative penalties.

COMMUNICATION AND SUPPORT

Where to Find Help

ADM

Course Resources

Google Classroom
Official location for assignments, due dates, announcements, submissions, and feedback.

LockwoodSTEM.org
Course hub for lessons, downloads, technical references, certifications, simulations, programming resources, and manufacturing project information.

Teacher Support
Jonathan Lockwood | D101, D102, D103 | After school until 4:00 PM | jlockwood@cornerstonecharter.com

Student Support and Accommodations

Students with documented accommodations will receive support in accordance with their educational plan. Students should communicate with the instructor when an accommodation, accessibility need, temporary injury, or other concern may affect safe participation, workcell operation, programming, simulation, testing, presentation, or completion of course work.

Class Amazon Wishlist

Families who would like to support the course may use the QR code below to view the class Amazon Wishlist. Contributions are optional and always appreciated, but they are never expected.

Optional Classroom Support

Wishlist items may include consumable materials, organization supplies, tools, replacement parts, and project resources that help expand student opportunities.

amazon.com/hz/wishlist/ls/2PEX0S3EFCNRY

SCAN TO VIEW

COMMUNICATION MATTERS
Students are encouraged to communicate early when they need clarification, additional help, or support completing a course requirement.

STUDENT AND FAMILY ACKNOWLEDGMENT

Review, Sign, and Return

ADM

Please review the course syllabus together. Return this signed page by the date posted in Google Classroom. The complete syllabus should be retained digitally for future reference.

By Signing Below, We Acknowledge That We Have Reviewed and Understand

- Course goals, learning outcomes, units, and major manufacturing projects
- Required materials and digital engineering notebook expectations
- Grading, late-work, revision, retake, and extra-credit policies
- FabLab, robotics, workcell, pneumatic, CNC, PPE, and equipment-safety expectations
- Collaboration, individual accountability, and academic integrity expectations
- Artificial intelligence expectations and disclosure responsibilities
- Communication platforms and procedures for requesting support

Student Information

______________________ Student printed name	______________________ Class period
______________________ Student signature	______________________ Date

Parent / Guardian Information

______________________ Parent/guardian printed name	______________________ Preferred phone
______________________ Parent/guardian signature	______________________ Date
______________________ Preferred email address	______________________ Best contact time (optional)

Optional Information for the Instructor

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THANK YOU

Thank you for supporting a safe, innovative, professional, and rigorous year of advanced manufacturing.