

Advanced Manufacturing 2

COURSE OUTLINE - UC

DESCRIPTION:

Advanced Manufacturing 2 is designed to prepare students for employment in the manufacturing industry. Students will engage in interdisciplinary learning of Science, Technology, Engineering, Art, and Math (STEAM) through a hands-on Project Based Approach. Students will receive advanced level exploratory instruction and guidance on topics including proper use of machinery tools, foundation in applied physics, basic concepts behind drive train systems, pneumatics, and actuators, designing and creating models using a laser cutter and CNC machine, analyzing design tools and simulations on created Computer-Aided Design (CAD), implementation of Introduction and Advanced STEAM concepts through real world applications of classroom concepts. Acquiring of knowledge will be demonstrated through a series of projects starting with research and initial design and culminating with the completion of a build project that is focused on solving real-world problems. Activities in this course include work-based learning that connects students to industry and the local community.

INFORMATION:

PRE-REQUISITE:	Advanced Manufacturing 1
LENGTH:	One Year
SECTOR:	Manufacturing and Product Development
PATHWAY:	Product Innovation and Design
ARTICULATED:	Yes
UC A-G APPROVAL:	Yes: College-Preparatory Elective (G) – Laboratory Science – Integrated Science Requirement

O*NET SOC CODES:

49-9041.00	Industrial Machinery Mechanics
51-4011.00	Computer-Controlled Machine Tool Operators, Metal and Plastic
51-4041.00	Machinists

Orientation
<ul style="list-style-type: none"> A. Introduce the course and facilities. B. Discuss the syllabus and major objectives. C. Explain applicable classroom management procedures, the ROP Student Rules of Conduct, and any operational guidelines. D. Review instructor/student expectations. E. Explain enrollment and attendance requirements and procedures. F. Review grading and student evaluation procedures. G. Discuss the community classroom aspect of the program if applicable. H. Discuss the “next steps” related to additional education, training, and employment. I. Review classroom safety, emergency and disaster procedures.
1. Communication Skills
<ul style="list-style-type: none"> A. Demonstrate positive verbal communication skills using appropriate vocabulary, demeanor, and vocal tone in the classroom and/or worksite. B. Read and interpret written information and directions. C. Practice various forms of written communication appropriate to the occupation. D. Practice positive body language skills. E. Practice professional verbal skills for resolving a conflict. F. Demonstrate active listening skills including techniques for checking for understanding, and for obtaining clarification of directions.
2. Interpersonal Skills
<ul style="list-style-type: none"> A. Demonstrate positive teamwork skills by contributing to a group effort. B. Practice the importance of diversity awareness and sensitivity in the workplace. C. Define sexual harassment in the workplace and identify the employee’s role and responsibility. D. Practice participation skills. E. Identify different personality types and strategies for working effectively with each type. F. Practice business and social etiquette skills appropriate to the occupation. G. Discuss the role of business and personal ethics in the decision-making process. H. Evaluate various job-related scenarios and justify decisions based on ethics. I. Demonstrate flexibility and adaptability in working with others. J. Demonstrate the use of time management skills.
3. Employability Skills

- A. Demonstrate appropriate attendance and punctuality practices for the classroom and worksite if applicable.
- B. Prepare a resume, cover letter, and job application forms.
- C. Demonstrate interviewing techniques using appropriate tone and body language.
- D. Demonstrate appropriate dress and grooming standards in seeking employment and for the workplace.
- E. Identify strategies for employment retention.
- F. Analyze the impact of social networking on employability.
- G. Identify the need for continuing education, professional development, and professional growth in chosen field.
- H. Identify appropriate procedures for leaving a job.
- I. Identify sources of job information, including electronic sources.
- J. Review company policies and current trends in employee compatibility screening, drug screening, and background checks.

4. Leadership

- A. Define leadership and identify the responsibilities, competencies, and behaviors of successful leaders.
- B. Work with peers to promote divergent and creative perspectives.
- C. Demonstrate how to organize and structure work, individually and in teams, for effective performance and the attainment of goals.
- D. Explain multiple approaches to conflict resolution and their appropriateness for a variety of situations in the workplace.
- E. Employ ethical behaviors and actions that positively influence others.
- F. Use a variety of means to positively impact the direction and actions of a team or organization.
- G. Analyze the short-term and long-term effects a leader's actions and attitudes can have on productivity, morale, and organizational culture.

5. Personal and Occupational Safety

- A. Demonstrate procedures to be followed in the case of emergencies.
- B. Discuss ways to report a potential safety hazard to a supervisor.
- C. Identify and discuss cyber ethics, cyber safety, and cyber security.
- D. Identify general shop safety rules and procedures.
- E. Identify types of hazardous waste, discuss related safety issues, and demonstrate proper handling and disposal procedures.
- F. Apply personal safety practices to and from the job.
- G. Describe the procedure for reporting a work-related hazard or injury.
- H. Recognize the effects of substance abuse in the workplace.
- I. Recognize immediate, potential, and hidden hazards.
- J. Perform housekeeping tasks related to maintaining a safe work environment.
- K. Pass a safety test with a perfect score prior to operating equipment.
- L. Demonstrate the proper safe use of tools and equipment.
- M. Identify safety color codes and their uses.

N. Explain the purpose and protocols of lock-out and tag-out procedures (LOTO).

6. Mechanical Drive Systems

- A. Classify the three types of levers.
- B. Calculate the mechanical advantage of inclined planes.
- C. Calculate the mechanical advantage of pulley systems.
- D. Calculate the mechanical advantage of gear drives.
- E. Create a drive system.
- F. Calculate RPM, shaft torque, rotary mechanical power, mechanical efficiency, and motor current.
- G. Convert between English and S.I. units of power.
- H. Install a flexible jaw coupling between two different shafts.
- I. Align shafts using a feeler gauge.
- J. Install a belt drive with multiple pulleys.
- K. Install a chain drive with multiple sprockets.
- L. Calculate the mechanical advantage of each of those systems.

7. Thermal Technology

- A. Define heat and temperature.
- B. Explain how heat and temperature apply to air conditioning and cold storage.
- C. Read both liquid and bimetallic thermometers.
- D. Convert between Celsius, Fahrenheit, Kelvin and Rankine temp scales.
- E. Calculate the change in length and change in volume of different materials given a temperature range.
- F. Calculate the change in internal energy of a substance given a specific temperature range.
- G. Solve problems using the ideal gas law.
- H. Demonstrate the ideal gas law using a fire syringe.
- I. Define vapor pressure and boiling point.
- J. Lower the vapor pressure in a container to make water boil at room temperature.
- K. Explain the three laws of thermodynamics and heat engines.
- L. Calculate the power and energy output of a miniature steam engine.

8. Programmable Logic Control

- A. Describe the advantages of using a PLC.
- B. Describe the six basic components of a PLC.
- C. Wire input/output devices to the PLC.
- D. Operate the PLC.
- E. Control multiple outputs.
- F. Create ladder diagrams illustrating the function of the PLC program.
- G. Convert between decimal and binary systems.

9. Structural Engineering

- A. Define the disciplines in civil engineering.
- B. Identify the types of structures.
- C. Explain the functions of structure types.
- D. Explain the concept of stability.
- E. Design three types of trusses and construct three different bridges for each truss.
- F. Identify force vectors.
- G. Construct three body diagrams for each bridge.
- H. Show why each bridge is in equilibrium.

10. AC/DC

- A. Define inductance and capacitance.
- B. Calculate inductance and capacitance.
- C. Hook up an inductor and capacitor in a DC and AC circuit.
- D. Hook up a combination circuit and solve for voltage, current, and equivalent resistance.
- E. Connect and operate a rheostat, voltage divider, and transformer.
- F. Design circuits on breadboards to model each type of circuit.
- G. Use a multimeter to verify voltage and current through a device.

11. Pneumatics

- A. Describe and operate a cam-operated valve with a 4/2 DCV (Directional Control Valve) and a 3/2 DCV.
- B. Use cam valves to design a circuit that will sequence two cylinders and slow down the cylinders using power braking.
- C. Define air logic.
- D. Hook up and operate externally piloted valves.
- E. Define vacuum pressure.
- F. Connect and read vacuum gauges.
- G. Connect and operate a Venturi, a manometer, a vacuum generator, and vacuum cups.
- H. Calculate the lift force of various vacuum cups at specified pressures.

12. CNC/CAM/CAD

- A. Calculate spindle speed, feed rate, and cycle time optimization.
- B. Use canned cycle for boring, counter-boring, spot boring and pecking functions.
- C. Calculate cutter compensation.
- D. Scale larger objects down to smaller, identical objects without changing code.

13. Portfolio Design

- A. Develop personal marketing and computer skills by refining your digital portfolio for post-secondary and employment acceptance.
- B. Compile best samples of original works and documents for a variety of purposes, which shows a progression in the acquisition of knowledge and/or skills.
- C. Demonstrate knowledge of competencies through journaling or summary of selected works or documents.
- D. Revise professional resume and cover letter to align with skills and objective statements of the relevant industry.
- E. Dress professionally and practice interviewing techniques using portfolio materials.
- F. Assemble industry and employability documents (resume, cover letter, certifications, recommendation letters, etc.).
- G. Create a "leave behind" book or folder.
- H. Display portfolio materials during a fair, community event, competition, or professional panel review.
- I. Evaluate and utilize feedback to improve portfolio.

Key Assignments

Assignment	Competencies	Career Ready Practices	Anchor Standards	Pathway Standards	CCSS
1. Students will participate in mock interviews that represent current industry practices (e.g., skills demonstrations, resumes, applications, portfolios, personal websites, etc.).	1 A, B, D 3 B, C, D, I, J	2 3 10	2 3		LS 11-12.6 SLS 11-12.2
2. Students will complete a research paper that focuses on the operation and application of recycling machines, current events in the world of recycling, and an individual organization that has influenced the field of steam power.	7A, I, K, L	11 12	2	D 2.0	W 11-12.4 W 11-12.7
3. Students will work on teams for a “visual effects company” and build a catapult for an upcoming movie. The catapult must be steam powered, have a torque-speed converter, throw a tennis ball 65 feet, be operated at least 15 feet away by some sort of electric control, reloads automatically via a robot arm, controlled by a PLC device, and have at least 2 parts that are manufactured by a CNC machine.	2 A, B, D, F, I, J 6 A-L 7A-L 8A-G	5 10	2 5 9	D 1.0 D 3.0	SL 11-12.1
4. After successfully building a catapult, students will predict how far a golf ball will travel, how long, in seconds; it will travel in the air, and test their hypothesis by conducting three consecutive test launches. Students will use analytical, expository writing to document and describe their work on the project, recording this information into their engineering notebook.	1 C 6 A-L	2 5	2 9	D 7.0	SL 11-12.1 SL 11-12.4 W 11-12.4

<p>5. Students will work on teams for a highway and bridge construction company. New construction on a bridge will not be complete for at least 10 years so students must design an interim bridge that will accommodate both road and waterway traffic. The drawbridge must be able to span 28 inches, be at least 6 inches wide, and have a mechanical efficiency of 100. The project must have a traffic light with 1 red and 1 green light. The light must turn red for 10 seconds before the drawbridge begins to lift. Students must hook up non-contact sensors that will detect the height of each boat that goes under the drawbridge. These sensors must only activate when a boat is too big to fit under the drawbridge. The students must wire the circuit that is designed on the breadboard with the PLC to control the operation. The PLC must also control a buzzer that will go off before the drawbridge raises and will provide barriers to the traffic. The barriers and the red light will not be able to turn off until the bridge is lowered. The project must have a pneumatically powered drawbridge that will be lifted slowly at first, then more quickly to prevent jolting. In the opposite direction, it must be lowered quickly at first then more slowly as the drawbridge closes back up. Boats must be transported onto the river (conveyor belt) using a vacuum system to carry them to prevent any damage to the outside hull of the boat. The boats must be various sizes and created in a CNC machine.</p>	<p>2 A, B, D, F, I, J 4C 9 A-H 10 A-G 11 A-H 12 A-D</p>	<p>5 10</p>	<p>2 5 9</p>	<p>D 1.0 D 3.0</p>	<p>SL 11-12.1</p>
<p>6. Create an invention and design report that focuses on the problems encountered how each team worked through each problem, the bill of materials that were used to build the project, and an explanation of why the final design was chosen. Students will then sell their product via a group sales presentation.</p>	<p>1 A-F 2 A, B, D, F, I, J 4B, C</p>	<p>2 9</p>	<p>2 9</p>	<p>D 10.0</p>	<p>SL 11-12.1 SL 11-12.4 SL 11-12.5 W 11-12.4</p>

Standards Assessed in this Program

Career Ready Practices

1. Apply appropriate technical skills and academic knowledge.
2. Communicate clearly, effectively, and with reason.
3. Develop an education and career plan aligned to personal goals.
4. Apply technology to enhance productivity.
5. Utilize critical thinking to make sense of problems and persevere in solving them.
6. Practice personal health and understand financial well-being.
7. Act as a responsible citizen in the workplace and the community.
8. Model integrity, ethical leadership, and effective management.
9. Work productively in teams while integrating cultural/global competence.
10. Demonstrate creativity and innovation.
11. Employ valid and reliable research strategies.
12. Understand the environmental, social, and economic impacts of decisions.

Anchor Standards

2.0 Communications

- Acquire and use accurately sector terminology and protocols at the career and college readiness level for communicating effectively in oral, written, and multimedia formats.

3.0 Career Planning and Management

- Integrate multiple sources of career information from diverse formats to make informed career decisions, solve problems, and manage personal career plans.

4.0 Technology

- Use existing and emerging technology, to investigate, research, and produce products and services, including new information, as required in the sector workplace environment.

5.0 Problem Solving and Critical Thinking

- Conduct short, as well as more sustained, research to create alternative solutions to answer a question or solve a problem unique to the sector using critical and creative thinking, logical reasoning, analysis, inquiry, and problem-solving techniques.

6.0 Health and Safety

- Demonstrate health and safety procedures, regulations, and personal health practices and determine the meaning of symbols, key terms, and domain-specific words and phrases as related to the sector workplace environment.

7.0 Responsibility and Flexibility

- Initiate, and participate in, a range of collaborations demonstrating behaviors that reflect personal and professional responsibility,

flexibility, and respect in the sector workplace environment and community settings.

8.0 Ethics and Legal Responsibilities

- Practice professional, ethical, and legal behavior, responding thoughtfully to diverse perspectives and resolving contradictions when possible, consistent with applicable laws, regulations, and organizational norms.

9.0 Leadership and Teamwork

- Work with peers to promote divergent and creative perspectives, effective leadership, group dynamics, team and individual decision making, benefits of workforce diversity, and conflict resolution.

10.0 Technical Knowledge and Skills

Apply essential technical knowledge and skills common to all pathways in the sector following procedures when carrying out experiments or performing technical tasks.

Pathway Standards

Manufacturing and Product Development - Product Innovation and Design Pathway

D1.0 Understand the basic product design and development process as it relates to the design of a product, line of products, system design, or services.

D2.0 Understand and apply research methodologies as a means to identify a need, problem, or opportunity for a new product, product line, system design, or service.

D3.0 Understand and apply various ideation techniques to develop ideas and concepts.

D7.0 Evaluate the prototype to determine if it meets the requirements and objectives.

D10.0 Produce a presentation of the product, product line, system design, or service.

Common Core State Standards

ENGLISH LANGUAGE ARTS

Speaking and Listening Standards

SLS 11-12.1: Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners, building on others ideas and expressing their own clearly and persuasively.

SLS 11-12.4: Present information, findings, and supporting evidence (e.g., reflective, historical investigation, response to literature presentations), conveying a clear and distinct perspective and a logical argument, such that listeners can follow the line of reasoning, alternative or opposing perspectives are addressed, and the organization, development, substance, and style are appropriate to purpose, audience, and a range of formal and informal tasks. Use appropriate eye contact, adequate volume, and clear pronunciation.

SLS 11-12.5: Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest.

Writing Standards

W 11-12.4: Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.

W 11-12.7: Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem, narrow or broaden the inquiry when appropriate, synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.