



Western Technical College

# 10664104 Rapid Prototyping

## Course Outcome Summary

### Course Information

<b>Description</b>	This course will introduce rapid prototyping as it relates to the prototype design of parts. Basic components will be designed and built using an additive process. The course will culminate in the design and manufacture of a robotic end effector that will manipulate a predetermined item.
<b>Career Cluster</b>	Manufacturing
<b>Instructional Level</b>	Associate Degree Courses
<b>Total Credits</b>	2
<b>Total Hours</b>	54

### Textbooks

No textbook required.

### Program Outcomes

1. Perform work safely.
2. Communicate technical information.

### Course Competencies

1. **Identify additive manufacturing technologies and characteristics.**

#### Assessment Strategies

- 1.1. Written Product

#### Criteria

*You will know you are successful when*

- 1.1. you apply terminology related to additive manufacturing.
- 1.2. you identify variations of additive manufacturing.
- 1.3. you identify file extensions used in additive manufacturing (STL, OBJ, 3MF).
- 1.4. you describe variations of additive manufacturing.

#### Learning Objectives

- 1.a. Explore variations of additive manufacturing ((SLA, FDM, SLS, Binder Jet, PolyJet, DMLS, EBM, Bio).
- 1.b. Differentiate between the variations of additive manufacturing and their applications in industry.
- 1.c. Determine the file type of a computer file.
- 1.d. Correlate additive manufacturing as rapid prototyping.

## **2. Perform setup to 3D print on a Fused Deposition Modeling (FDM) printer.**

### **Assessment Strategies**

- 2.1. Skill Demonstration

### **Criteria**

*You will know you are successful when*

- 2.1. you change the filament on an FDM printer.
- 2.2. you prepare the bed for a print on an FDM printer.
- 2.3. you accurately level the build plate on an FDM printer
- 2.4. you load a model from USB storage.
- 2.5. you print a loaded model on an FDM printer.
- 2.6. you safely remove an object from an FDM printer build plate.

### **Learning Objectives**

- 2.a. Locate the filament, guide tube, and extruder on an FDM printer.
- 2.b. Identify the steps of unloading and loading filament on an FDM printer.
- 2.c. Locate build plate adjustment knobs on an FDM printer.
- 2.d. Check the bed for accuracy and ensure the bed is level.
- 2.e. Locate the USB port.
- 2.f. Navigate the user interface of an FDM printer and begin printing a model.
- 2.g. Remove the build plate from the FDM printer and safely remove the object.

## **3. Examine custom slice settings.**

### **Assessment Strategies**

- 3.1. Skill Demonstration
- 3.2. Written Objective Test

### **Criteria**

*You will know you are successful when*

- 3.1. you open a model in various file types.
- 3.2. you identify the slicer settings that influence the quality, speed and strength of a printed object.
- 3.3. you customize the slicer settings for a durable, functional part.
- 3.4. you customize the slicer settings for a rough draft print.
- 3.5. you customer the slicer settings for a finely detailed, artistic print.

### **Learning Objectives**

- 3.a. Examine the various file types that can be printed (STL, OBJ, 3MF).
- 3.b. Explore two or more slicing software and their user interfaces.
- 3.c. Determine how to customize the slicer settings.
- 3.d. Examine the slicer settings that influence the quality, speed and strength of a printed object.
- 3.e. Load a model in to a slicer and prepare a printing file.
- 3.f. Identify how custom slicer settings control quality, shell, infill, material, supports and adhesion.
- 3.g. Explore how medium quality, slow speed, and high strength create a durable, functional part.

## **4. Connect a 3D printer to the network or wi-fi.**

### **Assessment Strategies**

- 4.1. Skill Demonstration

### **Criteria**

*You will know you are successful when*

- 4.1. you access a 3D printer's network or wi-fi information.
- 4.2. you connect to a 3D printer over the network or wi-fi.
- 4.3. you send a print file to a 3D printer over the network or wi-fi.

### **Learning Objectives**

- 4.a. Explore the user interface of a 3D printer.
- 4.b. Explore the connectivity options between a slicer and 3D printer.
- 4.c. Connect to a network 3D printer to print a model.

## **5. Maintain an FDM Printer.**

### **Assessment Strategies**

- 5.1. Skill Demonstration

### **Criteria**

*You will know you are successful when*

- 5.1. you identify different methods to declog a nozzle.
- 5.2. you clear a clogged nozzle.
- 5.3. you replace the build tape plate.
- 5.4. you remove and clean the build tape plate.
- 5.5. you explain the importance of keeping your spool wound tightly.

### **Learning Objectives**

- 5.a. Replace the build plate tape.
- 5.b. Remove and clean the build plate.
- 5.c. Identify common extruder issues.
- 5.d. Troubleshoot clogged nozzles.
- 5.e. Repair clogged nozzles.
- 5.f. Untangle the spool of filament.

## **6. Troubleshoot problems in the 3D printing process or settings by inspecting a 3D printed object.**

### **Assessment Strategies**

- 6.1. Self Assessment

### **Criteria**

*You will know you are successful when*

- 6.1. you identify the cause of a problem of a printed object.
- 6.2. you identify the solution to that problem.
- 6.3. you implement the solution.
- 6.4. you verify if problem has been resolved.
- 6.5. you research alternative solutions if needed.

### **Learning Objectives**

- 6.a. Explore common problems in printed objects (i.e. stringiness, surface texture, "elephant's foot", gaps in print).
- 6.b. Explore common causes of problems (i.e. temperature settings, speed, calibration concerns, geometry of the part).
- 6.c. Resolve identified problems.
- 6.d. Research additional solutions to problems.

## **7. Model an object using CAD software.**

### **Assessment Strategies**

- 7.1. Product - end effector

### **Criteria**

*You will know you are successful when*

- 7.1. you design an end effector that will manipulate a pre-determined item.
- 7.2. you create a solid model based on the design in the chosen software.
- 7.3. you modify the design as needed.

### **Learning Objectives**

- 7.a. Explore the user interface.
- 7.b. Identify the tools to create a 3D object.
- 7.c. Recreate a 2D orthographic drawing into a 3D object.
- 7.d. Identify components of an end effector.
- 7.e. Create a model of a pre-determined item.

7.f. Modify a file (edits, revisions, etc.)

## 8. Prepare your model for printing.

### Assessment Strategies

8.1. Product - end effector

### Criteria

*You will know you are successful when*

- 8.1. you export the file.
- 8.2. you import the file to the slicer.
- 8.3. you determine the best orientation of the file.
- 8.4. you verify the scale of the file.
- 8.5. you select the appropriate settings of the slicer.
- 8.6. you export the print file.
- 8.7. you print.

### Learning Objectives

- 8.a. Determine the best orientation for printing.
- 8.b. Export the file in a 3D printing file format (ex: STL, OBJ, 3MF).
- 8.c. Verify the scale of the exported file.
- 8.d. Load the file into the slicer.
- 8.e. Verify slice settings.
- 8.f. Export the slice file.
- 8.g. Print the file.