OET010 Manufacturing Processes Rubric Guide **Updated May 2, 2017**

The purpose of this guide is to provide a range of knowledge at which students can demonstrate proficiency for each objective. Subsequent college course success depends strongly on courses taught primarily at the "some applied skills demonstrated" and "applied skills strongly demonstrated" levels.

TAG Learning Outcomes	Applied skills strongly demonstrated	Some applied skills demonstrated	Little applied skills demonstrated	No applied skills demonstrated
1. Demonstrate an understanding of the interrelationships between material properties and manufacturing processes.*	• Develop a manufacturing plan based on the interrelationships between material properties and manufacturing processes needed to produce the part. • Decide the best manufacturing processes for various parts based on the material properties. • Explain why material selection is integral to design and manufacturing. • Discuss the impact of poor or improper material selection on product reliability and product failure liability. • Heat treat specimens to determine material and carbon content and match to hardness achieved.	• Analyze and classify the interrelationships between material properties and manufacturing processes. • Differentiate the manufacturing process that is used on common material properties. • Discuss material selection and manufacturing process criteria. • Discuss impact of material selection on design, manufacturing, assembly. • Understand the effect of steel additives such as sulfur to machining properties.	• Explain and discuss the interrelationships between material properties and manufacturing processes. • Explain hardness related to tensile strength. • Identify basic dynamic properties (impact, fatigue, creep). • Define machinability, formability, and weld ability. • Understand chip formation and effect of material microstructures.	• Define the interrelationships between material properties and manufacturing processes. • Define characteristics of metallic and non-metallic materials. • Identify basic physical properties of materials (density, thermal, optical, electrical). • Identify basic mechanical properties of materials (stress, strain, tensile, elongation, yield strength, shear strength—material removal), ductility, brittleness, toughness, hardness, and hardness scales (e.g., Brinell, Rockwell).
2. Distinguish between different manufacturing processes such as forgings, extrusions, castings, forming, and finishing.*	• Construct and propose a plan to use the different manufacturing processes such as forgings, extrusions, castings, forming and finishing, completing parts in	• Analyze and classify the between the different manufacturing processes such as forgings, extrusions, castings, forming and finishing.	• Explain and discuss the differences between different manufacturing processes such as forgings, extrusions, castings, forming and finishing. • Identify, describe, show	• Define the different manufacturing processes such as forging, extrusion, casting, forming and finishing. • Identify, describe, and give

	the most efficient manner. • Given a product, identify how that product is likely made, and validate or correct the answer using research. • Make patterns for sand casting and pour an aluminum part. • Understand gating and venting needs in a casting.	• Construct a process for making many different parts using the various manufacturing processes. • Plan a manufacturing process to make certain products. • Know when a forging is best and the benefits of forging properties. • Understand when grinding and polishing are necessary and the material removal.	examples of products made using electro-chemical and electric discharge processes. • Explain how threads are made. Identify types of threads and applications for each.	examples of products made using material removal processes such as turning, milling, drilling, threading, and sawing. • Identify, describe, and give examples of products made using forming, extruding, and casting. • Identify, describe, and give examples of products made using finishing processes such as grinding, sanding, coatings, and annealing.
3. Distinguish between different fabrication processes such as welding, fasteners, and adhesives.*	• Construct and propose a plan to use the different fabrication processes such as welding, fasteners, and adhesives to produce parts in the most efficient manner. • Evaluate the strengths and weakness of each of the fabrication processes such as welding, fasteners, and adhesives when it comes to the production of parts. • Given a product, identify how that product is likely fabricated, and validate or correct the answer using research.	• Analyze and classify the different fabrication processes such as welding, fasteners, and adhesives. • Distinguish the different types of Fusion welding, Resistance welding, and brazing. • Construct a process for making many different parts using the various fabrication processes. • Plan a manufacturing fabrication process to make certain products. • Know what the UNC UNF bolt thread classes are and Metric. • Tap and Die to create threads.	• Explain and discuss the differences between different fabrication processes such as welding, fasteners, and adhesives.	• Define the different fabrication processes such as welding, fasteners, and adhesives. • Identify, describe, and show examples of types of fasteners. • Identify, describe, and show examples of type of adhesives. • Identify, describe, and show examples of types of welding processes.

4. Apply process parameters to optimize production efficiencies.*	• Construct and propose a plan to use the different empirical data to determine speeds and feeds to optimize production efficiencies. • Produce the Speed and Feed data from the charts based on the material and machining process and calculate the proper feed and speed based on that different machining process. • Evaluate the findings and determine if a different machining process would be required to optimize production efficiencies. • Create a CNC program using manual G code technique to cut a part. • Analyze and classify the empirical data to determine speeds and feeds to optimize production efficiencies.	• Produce the Speed and Feed data from the charts based on the material and machining process and calculate the proper feed and speed based on that different machining process. • Calculate N (RPM) using N=(12*V) /(π*D); Use and validate that V=(N*π*D)/12, and apply to real manufacturing examples. • Calculate forces (Fc- cutting force, Ff-feed force, and Fr-radial force) on a single point tool. • Show how these forces can be used to design fixtures, tool holders, and drive systems. • Calculate material removal rate (MRR). • Calculate HPspindle given HPs and MRR. • Know the effect of speeds and feeds on surface finish and material removal ranges.	• Explain and discuss the empirical data to determine speeds and feeds to optimize production efficiencies. • Discuss efficiency and energy losses. • Determine HP motor using efficiency and HP spindle. • Explain that material removal is causing material to fail in shear. • Recognize three feeds; feed in inches per minute, in inches per revolution, and in inches per tooth. • Using a given feed, determine the other two feed rates where appropriate. • Use feed rate to determine cut time. • Understand relationship of each feed to the process. • Look up and demonstrate understanding of specific (or unit) HPs given material.	• Describe speeds and feed to optimize production efficiencies. • Understand that all manufacturing operations have limits (machine size, HP, tool size, finish, etc.). • Use machinability reference books to look up suggested speeds and feeds. • Identify values generally looked up in a reference book or required by the manufacturing operation (depth of cut, V, diameter of part or tool, and feed rate).
5. Demonstrate appropriate safety procedures and methods in a manufacturing setting.*	• Construct and propose safety procedures and methods in a manufacturing setting to insure the safety of the employees.	• Analyze and classify appropriate safety procedures and methods in a manufacturing setting. • Determine what is safe and	• Explain and discuss the appropriate safety procedures and methods in a manufacturing setting. • Discuss OSHA and other safety	• Describe the appropriate safety procedures and methods in a manufacturing setting. • Demonstrate

	• Develop appropriate safety procedures and methods in a manufacturing setting.	unsafe in the many different manufacturing settings.	enforcement agencies. • Discuss importance of safety to industry productivity.	understanding of and need for Personal Protection Equipment. • Demonstrate understanding of and need for Lock Out Tag Out. • Demonstrate understanding of and need for fall protection. •
6. Demonstrate proficiency in the use of measurement instruments.*	• Select the proper measurement instruments based on the instruments accuracy and precision. • Perform the proper steps to determine the correct measurement on various features. • Know the vernier scale. • Read micrometer to fabricate and know precision.	• Compare the differences of use of the measurement instruments. • Produce the correct measurement on various features. • Calculate allowance/ interference and tolerance values for various classes of fit. • Solve and apply class of fit problems. • Read a vernier caliper to produce quality parts. • Know dimensional metrology and how to measure parts to within 1 thousandth accuracy.	• Explain the use of measurement instruments. • Demonstrate the proper use of each type of measurement instruments. • Discuss class of fit in design of mating parts. • Identify the difference between tolerance and allowance/interference. • Demonstrate understanding of how to measure parts given dimensions and specifications.	• Describe the use of different measurement instruments. • Identify and describe the need for tolerances. • Demonstrate understanding of tolerance. • Demonstrate proficiency in reading vernier, dial, and digital calipers and micrometers. • Demonstrate proficiency in reading linear scales and gages. • Describe relationship and importance of measured values to specifications.