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 present" and "applied skills strongly demonstrated" levels.

Objective	Applied skills strongly demonstrated	Some applied skills present	Little applied skills present	No applied skills Present
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 ~~5~~ 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 affect 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, hardness scales (e.g. Brinell, Rockwell)

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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 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.	• Analyze and classify the between the different manufacturing processes such as forgings, extrusions, castings, forming and finishing. • 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.	• Explain and discuss the differences between different manufacturing processes such as forgings, extrusions, castings, forming and finishing. • Identify, describe, show examples of products made using electro-chemical and electric discharge processes • Explain how threads are made. Identify types of threads and applications for each.	• Define the different manufacturing processes such as forging, extrusion, casting, forming and finishing. • Identify, describe, and give 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,	• Construct and propose a plan to use the different fabrication processes such as	• Analyze and classify the different fabrication processes such as welding,	• Explain and discuss the differences between different fabrication processes	• Define the different fabrication processes such as welding, fasteners, and

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and adhesives.	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. • ~~Fillet weld with electric arc on steel parts.~~ • ~~Tig and mig processes.~~ • ~~Understand weld symbols and applications.~~	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.	such as welding, fasteners, and adhesives.	adhesives. • Identify, describe, show examples of types of fasteners. • Identify, describe, show examples of type of adhesives • Identify, describe, show examples of types of welding processes
4. Apply empirical data to determine speeds and feeds to optimize production efficiencies.	• Construct and propose a plan to use the different empirical data to determine speeds and feeds to	• Produce the Speed and Feed data from the charts based on the material and machining process	• Explain and discuss the empirical data to determine speeds and feeds to optimize production	• Describe speeds and feed to optimize production efficiencies.

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	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.	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	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	• 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)

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		ranges.		
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. • Develop appropriate safety procedures and methods in a manufacturing setting. • ~~Apply OSHA regulation to a casting machining and welding operation.~~	• Analyze and classify appropriate safety procedures and methods in a manufacturing setting. • Determine what is safe and unsafe in the many different manufacturing settings. • ~~Use various media to view examples of safety devices, processes, and examples of poor safety practices.~~	• Explain and discuss the appropriate safety procedures and methods in a manufacturing setting. • Discuss OSHA and other safety enforcement agencies • Discuss importance of safety to industry productivity	• Describe the appropriate safety procedures and methods in a manufacturing setting. • Demonstrate 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	• Compare the differences of use of the measurement instruments. • Produce the correct measurement on various features. • Calculate allowance/interferenc	• Explain the use of measurement instruments. • Demonstrate the proper use of each type of measurement instruments. • Discuss class of fit in design of mating	• Describe the use of different measurement instruments. • Identify and describe the need for tolerances. • Demonstrate understanding of

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	on various features. • Know the vernier scale. • Read micrometer to fabricate and know precision.	e 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.	parts. Identify the difference between tolerance and allowance/interferenc e. • Demonstrate understanding of how to measure parts given dimensions and specifications	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.
7. Tour local manufacturing facilities (optional)	• Propose some different manufacturing process at the local manufacturing facilities. • Tour local manufacturers – at least 2 per semester as needed.	• Compare the difference manufacturing process at the local manufacturing facilities.	• Explain the use of the different manufacturing process at the local manufacturing facilities. • Use various media and tours to explain manufacturing processes and how products are made.	• Describe the tour of manufacturing facilities. • Participate in tours of manufacturing facilities • Use guest lecturers to discuss current topics affecting local manufacturing industry • Use videos and other media to demonstrate manufacturing processes and systems

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