IT 208 – Manufacturing Processes (D102)

Fall 2013

Instructor: Bruce DeRuntz, PhD, CSSBB, CQE, ASQ Fellow
Class Time: Tuesday and Thursday 9:35 – 10:50 am
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Course Objective
To enable the student to understand the theory and principles of traditional manufacturing processes used by industry as metal casting, forming and shaping, material removal and joining.

Course Format

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Grading Assignment
A: 720 – 800
B: 640 – 719
C: 560 – 639
D: 480 – 559
F: < 479

Textbook (Required)

Administrators, instructors, and graduate assistants reserve the right to modify the syllabus anytime throughout the course.
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Tests
There will be four (4) tests and one (1) final exam given on the days listed on the course calendar. They will be taken a computer lab in the CASA building during class hours. You will be given 40 minutes to take each test. All tests are online and can only be taken in the room indicated. THERE WILL BE NO MAKE UP TESTS.

Homework
Each lesson has a corresponding homework assignment that is located in the lesson’s learning module. Each homework assignment is worth 5 points. Homework will be made available 2 weeks before it is due and is due by class time on the day that chapter is covered. LATE HOMEWORK WILL NOT BE ACCEPTED.

Project (Article Summary and Presentation)
The semester project consists of an article summary and presentation over a NEW (developed within the last 10 years) manufacturing process. Topics must be approved by October 31st. Both the article summary and PowerPoint presentations are due on Friday, November 26th with presentations taking place following Exam 4. The article should come from a journal, magazine, or credible website that deals with manufacturing or quality issues and discusses the new technology. I will provide an outline on how both the summary and presentation will be graded. Guidelines for the article summary are listed below.

Format:
Coversheet

Body
- Title of Article, Author, Sources(s) (volume, pages, etc)
- Purpose of the article
- Key points (Bullet form is recommended)
- Findings, Conclusions

Format
- Stapled, 12 pt. font, Times New Roman, 2.0 spacing, 1” margins
- Summaries are limited to 3 pages, excluding title page
- Summaries will be graded for uniqueness of process, readability, grammar, spelling, punctuation, etc.

Presentation
- 5 minute (timed) summary using PowerPoint
LEARNING OBJECTIVES: Upon completion of this course the student should be able to perform the following:

Section 1: Manufacturing Today

Chapter 1: Introduction to Manufacturing
• Define ‘maquiladoras’ and list the participating nations of NAFTA.
• Define manufacturing.
• State how many industries are classified using the classification system NAICS.
• List components of lean manufacturing.

Chapter 2: Material and Process Classification
• Recall the purpose of the North American Industry Classification System (NAICS).
• List five major material families in the manufacturing of hard good consumer products (durable goods) and list examples.
• Recognize the difference between primary and secondary material processing industries.
• List the major processing actions used to classify types of manufacturing processes.

Section 2: Material and Process Classifications

Chapter 3: Planning for Production
• Recognize that lean manufacturing is a systematic approach to eliminate non value activities (waste).
• List the 3 steps to implement SPC and when the system may be out of control.
• Differentiate between push and pull manufacturing systems.
• Comprehend kanban and its use.

Chapter 4: Identifying Opportunities for Improving Manufacturing Processes
• Recall that robustness is a characteristic of a well-designed manufacturing process by using experimentation.
• Interpret the two principles of quality used to improve the design of both the process and the product.
• Define dependent variable and interaction.

Section 3: The Decision to Automate

Chapter 5: When to Consider Automation
• Recall an automated manufacturing process is designed to consistently replicate a product.
• Recognize that productivity and quality improvement programs must be completed before automation is attempted.
• Recall products must be designed for manufacturability (manually or automated).
• Recognize if cost reduction is the major goal, then automation may not be necessary after all the pre-automation steps are completed.
Chapter 6: Automated Manufacturing Systems

- Define Automation
- Distinguish between hard and soft automation and list examples.
- Identify systems as either closed-loop or open-loop and list the components.
- Recall programming control systems for automated machines and processes has been facilitated with the integration of product design software and manufacturing software systems.

Chapter 7: Sensors and Devices for Automation

- Recall sensors are devices that gather information for control systems and list an example of each type.
- Define transducer.
- Indicate if plug-and-play sensors make it easier to create and modify computer-based control systems.
- Distinguish the differences among discrete, binary, and analog devices.

Section 4: Selecting Appropriate Materials

Chapter 8: Behavior and Characteristics of Manufacturing Materials

- Identify the three performance criteria important to the selection of materials.
- Recall the definition of hazardous waste from the Environmental Protection Agency (EPA).
- Recall the importance of Materials Safety Data Sheets (MSDS) for identifying and classifying materials.
- Comprehend laws regulating knowledge, transportation, and disposal of hazardous waste.
- Recognize the four types of hazardous wastes by the list type.

Chapter 9: Characteristics of Metallic Materials

- Identify the four physical properties that are used to classify metals.
- Recognize there are four major types or classifications of metals.
- Identify the physical and mechanical properties of metals.
- Distinguish between iron and steel, the two major types of ferrous metals.
- Recall the method for classifying super-alloys according to base metals.
- Discuss techniques used to identify types of steel.

Chapter 10: Characteristics of Plastic Materials

- Recognize plastics as an engineered or human-made material.
- Comprehend the cost advantages often gained by substituting plastics for other manufacturing materials.
- Decipher the difference between resins and plastics.
- State when commodity resins are used instead of engineered resins.
- Identify how thermoplastics are formed.
- Recall that thermosets do not melt upon reheating.

Chapter 11 will not be covered
Chapter 12: Characteristics of Ceramic Materials
- Distinguish the two major divisions in the ceramic industry.
- Recall types of ceramic stock used by manufacturers including synthetic materials such as high temperature carbide and alumina Titania, and natural materials such as soapstone and clay feldspar.
- Recall that Bioceramic devices have been developed that bond to bone and are gradually assimilated into the bloodstream of humans and animals.
- Recognize humans throughout history have used traditional ceramics.
- Recall industrial ceramics evolved in the 1960s and 1970s with the advent of engineered and composite materials.

Chapter 13: Characteristics of Composite Materials
- Recognize composites have unique characteristics that make it possible to build products that otherwise would be unavailable or cost prohibitive.
- Recall fiber reinforced plastic is replacing the term glass reinforced plastic.
- Name the two primary components of any composite material.
- Recall resins form the composite matrix.
- Recall additives, fillers, and colorants that are added to the matrix are to enhance specific properties of a composite.

Section 5: Manufacturing Process Database

Chapter 14: Processes Used to Form Metallic Materials
- Recognize some forming processes take advantage of a metal’s property to flow like plastic to conform to a new shape.
- Name a forming process that shapes metal by cutting away material that is not needed.
- Recall casting processes are not entirely used with molten metals.
- Name several different processes used to form metals.
- Define thread rolling.

Chapter 15: Processes Used to Form Plastic Materials
- Recognize there are two major types of forming processes used with plastics.
- List the five major closed molding processes.
- Name open molding processes used to make products such as boat hulls and shower enclosures.
- Recall blow molding processes are often used for high-volume production of bottles and other containers.
- Define a runner for plastic injection molding.

Chapter 16: Will not be covered

Chapter 17: Processes Used to Form Ceramic Materials
- Recall there are four major types of ceramic forming processes.
- Recognize most industrial ceramic parts are formed by the dry pressing method.
- List the four steps for ceramic dry pressing.
- Define a Deflocculants.
Chapter 18: Processes Used to Form Composite Materials

- Recognize one of the most common processes used to form composites is open molding.
- Distinguish closed-molding systems are more expensive but they offer some advantages that cannot be attained in open molding.
- Recall many of the forming processes for composites are tailored to specific applications to provide the necessary performance features desired for that product.
- Distinguish between vacuum bagging and infusion molding.

Chapter 19: Processes Used to Separate Metallic Materials

- Define shearing.
- Recognize chip-making machine tools are extremely versatile and automated.
- Recall that cutting tools are highly specialized and enable machining and turning centers to remove high volumes of metal quickly and accurately.
- Identify drilling as a common operation that requires cutting tools that have been designed exactly for that purpose.
- State grinding can finish parts to exact dimensions with a fine surface finish.
- Recall there are several processes that have been developed to cut or remove material in difficult situations with precision and with a minimum of stress on the part.

Chapter 20: Processes Used to Separate Plastic Materials

- Recognize proper selection of cutting speed and saw-tooth shape is important for efficient material removal when cutting plastics.
- Recall cutting speed is calculated in feet per minute, as measured along the circumference of the cutting tool.
- Recognize twist drill bits for plastic are ground to a sharper angle than those used for metal.
- Recall cutting speeds must be calculated carefully to avoid material breakage.
- Identify 5 processes to cut plastic materials.

Chapter 21: Will not be covered

Chapter 22: Processes Used to Separate Ceramic Materials

- List the various types of milling processes to grind clay into extremely fine particles for mixing as slurry (glass, ceramic, or steel media).
- Name methods used to remove excess water from bulk ceramic material.
- Comprehend stock for dry pressing is ground and milled with a variety of processes.
- Recall removal of excess or unwanted material from sintered work-pieces is typically done by grinding.

Chapter 23: Processes Used to Separate Composite Materials

- Recognize abrasive sawing separates composites with a minimum of damage.
- Identify water jet cutting as a fast and dust-free method for separating composites.
- Recognize lasers work well in cutting some composites.
- Recall ultrasonic machining provides a fast, precise, and reliable means to cut many of the reinforcement materials used in composites.
Chapter 24: Processes Used to Fabricate Metallic Materials

- Recall that mechanical joining, which includes threaded fasteners, have the unique ability to generate large clamping forces.
- Recognize welding joins metals by melting adjoining surfaces so that they are able to fuse together.
- Comprehend ultrasonic welding uses sound energy to generate heat for joining metals or plastics.
- List two of the oldest and most versatile processes used to join metals.

Chapter 25: Processes Used to Fabricate Plastic Materials

- Recognize cohesive joining is used to permanently assemble plastic parts.
- Recall an embedded wire, used with dielectric heating, is one means of welding plastics.
- Recognize that high-frequency vibrations are used to generate frictional heat as a means of joining plastics.
- Recall molecular movement caused by radio-frequency waves creates the heat needed to seal products made of thermoplastic polyurethane or polyvinyl chloride.
- Name eight different types of materials are used to bond plastics.

Chapter 26: Will not be covered

Chapter 27: Processes Used to Fabricate Ceramic Materials

- Comprehend ceramic materials often must be joined to other materials with joints that are not only mechanically strong, but airtight, watertight, or both.
- Recall metallizing techniques are used to provide electrically conductive pathways on ceramic substrates.
- Recognize glass-to-glass and metal-to-glass bonds usually involve heat application to form fusion seals.
- State metal coatings are applied to ceramics for decorative, electrical, and sealing purposes.
- Distinguish refractory ceramic materials, in forms ranging from bricks to spray coatings, are used to line industrial furnaces and for other high-temperature applications.

Chapter 28: Processes Used to Fabricate Composite Materials

- Recognize cohesive fabrication is the method used for forming a composite in an open mold.
- Recall secondary bonding is joining together two or more previously cured parts.
- Recognize the adhesion process is frequently used in place of cohesive methods to join two parts.

Chapter 29: Processes Used to Condition Metallic Materials

- Recognize manufacturers have the ability to change the mechanical properties of metallic materials.
- Recognize selecting the appropriate alloy is essential to obtain the desired mechanical properties.
- Recall heat-treating is the most widely used process to alter the mechanical properties of metals.
• Name 3 mechanical properties that can be changed by heat-treating.

Chapter 30: Processes Used to Condition Plastic Materials
• Recall chemical blowing agents are used to produce lightweight cellular plastics.
• Recognize plastics are often annealed to relieve stresses caused by processing activities.
• Recall the rate of polymerization for certain plastics can be increased by exposing them to radiation.
• Recall polyanisidine (PANIS) is a conductive polymer that can be used as a temporary replacement for solder in some electronics applications.
• Recognize polyphenylene sulfide plastic, providing up to 50 times more thermal conductivity than conventional plastic, is used by manufacturers of stepper motors to carry heat away from the motor and into the air.

Chapter 31: Will not be covered

Chapter 32: Processes Used to Condition Ceramic Materials
• Recall sintering is the most common method of increasing the density of a ceramic workpiece.
• Recognize that porosity and potential for absorbing moisture of a ceramic workpiece is important.
• Recognize most ceramic products must be dehydrated before they can be fired.
• List the four major types of sintering used in producing ceramic products.
• Recognize reaction sintering, used to produce ultradense parts, results in a near-net-shape product.
• Name how pyrometric cones are used.

Chapter 33: Processes Used to Condition Composite Materials
• Recall there are a variety of methods that can change the behavioral characteristics of a composite.
• Recognize several processes can make a composite surface more conducive to resin adhesion.
• Recall the thermal conductivity and specific gravity of a composite can be changed by introducing additives to the resin.

Chapter 34: Processes Used to Finish Metallic Materials
• Recall detergent washing is a common process used to prepare metal parts prior to applying a decorative or protective finish.
• Recognize burrs are an unwanted result from many forming and fabricating operations and must be removed prior to finishing.
• Recognize electroplating applies a decorative and protective metallic coating to metal.
• Name a popular method for finishing metal parts that can be accomplished using a variety of processes.

Chapter 35: Processes Used to Finish Plastic Materials
• Recall phenolic resins can be applied at the worksite by spraying to protect the interior of large chemical storage tanks.
• List how plastisols are used.
• Comprehend extremely fine particles of thermoplastic resin can be suspended on air currents and act as a fluid for finish-coating of thermoset materials.
• List how 3 metallic coatings can be applied by vacuum metallizing, electroplating, or electroless (chemical) plating.
• Name one of the most popular processes used in industry today that creates a uniformly distributed coating, even on the back side of a round or irregularly-shaped part.

Chapter 36: Will not be covered electrostatic powder coating

Chapter 37: Processes Used to Finish Ceramic Materials
• List two processes used to remove minor imperfections on the surface of a ceramic product.
• Recall grinding can often be used to remove larger defects in ceramic work-pieces.
• Name 3 ways that glazes can be applied.
• Comprehend decorations can be applied to ceramics before glazing or after glazing.

Chapter 38: Processes Used to Finish Composite Materials
• Recall a finish for a composite may be integral to the composite or applied after the composite has been formed.
• Recognize colorants may be added to the matrix resin to create an integral finish.
• Comprehend finished surfaces can be created using a laminate to impart unique characteristics.

Chapter 39: Will not be covered
**Academic Conduct**
Cheating on examinations, submitting work of other students as your own, or plagiarism in any form will result in penalties ranging from an F on the assignment to expulsion from the university, depending on the seriousness of the offense.

**Emergency Procedures:**
Southern Illinois University is committed to providing a safe and healthy environment for study and work. Because some health and safety circumstances are beyond our control, we ask that you become familiar with the SIUC Emergency Response Plan and Building Emergency Response Team (BERT) program. Emergency response information is available on posters in buildings on campus, available on the BERT's website at [www.bert.siu.edu](http://www.bert.siu.edu), Department of Public Safety's website [www.dps.siu.edu](http://www.dps.siu.edu) (disaster drop down) and in the Emergency Response Guide pamphlet. Know how to respond to each type of emergency. Instructors will provide guidance and direction to students in the classroom in the event of an emergency affecting your location. **It is important that you follow these instructions and stay with your instructor during an evacuation or sheltering emergency.** The Building Emergency Response Team will provide assistance to your instructor in evacuating the building or sheltering within the facility.