Virginia Western Community College
MEC 113
Materials and Processes of Industry

Pre or Co-requisites
None

Course Description
Supervises on-the-job training in selected business, industrial or service firms coordinated by the college. Credit/practice ratio not to exceed 1:5 hours. May be repeated for credit.

Studies engineering materials and accompanying industrial manufacturing processes. Investigates nature of materials structure and properties from a design standpoint. Analyzes the effects of the various processes on materials and the process themselves. Includes machining, casting, forming, molding, hot/cold working, chipless machining, and welding. Addresses quality assurance and inspection procedures.

Semester Credits: 3 Lecture Hours: 3 Lab/Recitation Hours: 0

Required Materials

Textbook:

Engineering Materials- Properties and Selection, 9th ed., Author: Budinski, Publisher: Prentice Hall, ISBN# 9780137128426

Other required materials:

1. Handouts and web sites as provided by instructor and as displayed on the class BLACKBOARD site.

2. Each student will be required to visit the web site and complete the weekly class post and pretests.

Course Description

This course is divided into two major parts: a section on process management and a section that focuses on the function and importance of a hands-on design project. In each case, a blueprint is presented to instructors that they can use when implementing the course at their school.

For the process management component, a factory simulation is conducted. Each participant is assigned a role and the rules of the simulation are discussed. After a series of runs of the simulation, a discussion and presentation is made, where participants not only present their performance and progress data but also track what they learned.

For the hands-on design project component, instructors are encouraged and supported in creating a useful design project for students. Students are divided into teams, informed of the rules of the project, given a timeline, budget and a “customer”, as well as other parameters. After completing the project, students present their results and learning outcomes.

Course Philosophy

This course is the last in a series of six courses which prepare students for certification as a Siemens Certified Mechatronic Systems Associate. The job profile for which the Level 2 certification prepares students is that of a technician who has a well-rounded understanding of the complex inter-relationships and inter-workings of a mechatronic system.

This course, as all courses within the Certification Program, is based upon a systems-oriented approach. Students learn about individual components and system characteristics within the context of an actual mechatronic system. At the beginning of this course, students should first be presented with a complex system. Ideally, this system is physically available at the educational institution and within the first class meetings should be visited by the students. By focusing on an actual system, students understand clearly why they are learning the subject material. This increases significantly the learning effect and promotes a fuller understanding of the material

being learned. By viewing the system as a whole, learning retention is also increased, as the student experiences the components as part of a whole, rather than in isolation.

Of great importance is that the student is able to transfer the knowledge learned to a new system and is able to quickly familiarize himself with the new system.

This understanding leads to a better informed employee who has sufficient knowledge to make well-informed decisions about the running of the system upon which he or she is working.

For this course in particular, it is recognized as very important the ability for engineering technology students to have an awareness of what it is like to work with customers, timelines, budgetary restrictions, and in general to include some basic business sense in the spirit of their work. While this course is not a business course by any means, it emphasizes business-related factors that employers express an increased desire for when selecting mechatronics technicians at this level.

Course Goals

Upon completion of the course, students should:

1. Understand the concepts presented in the factory simulation, including Cycle Time, Production Time, First Pass Yield, and Barrier Identification.
2. Understand how to make a process map.
3. Understand how to read a Cost Breakdown.
4. Understand the various roles on Project Teams.
5. Understand Project Team Organization and Evaluation.

Course Objectives

At the conclusion of this course, students will be able to:

1. Work with mechatronic systems with a process-oriented perspective
2. Give meaningful recommendations on how to improve manufacturing and work processes.
3. Express an appreciation for the role of the customer in the larger manufacturing picture.
4. Work on a project with significant time and budgetary constraints.
5. Work as an effective member of a team.
6. Evaluate project work in such a way that translates to future increased effectiveness in such tasks.

Course Prerequisites

None. Proficiency with MS Office or related tools can be useful.

Course Outcomes

At the completion of this course, the student should be able to demonstrate:

1. The student will be able to select a material for an application based on the use environment and manufacturing method.
2. The student will have a broad knowledge of the methods used to manufacture metals and plastics into finished products.
3. The student will have knowledge of the methods used to produce metals from ore to finished raw material.
4. An appreciation of the methods and benefits of the strengthening and processing heat treatments.
5. The student will have a familiarity with casting and advanced material shaping and forming processes.

Topical Description

Week	Topic
1	Introduction to class. Chapter 1 The Importance of Engineering Materials/ Chapter 2 Forming Engineering Materials from the Elements
2	Continued Chapter 2 and Chapter 3 The Role of Chemical and Physical Properties in Engineering Materials/ Chapter 4 The Role of Mechanical Properties in Engineering Materials
3	Continued Chapter 4 and Chapter 12 Steel Products
4	Chapter 13 Heat Treatment of Steel
5	Chapter 14 Carbon and Alloy Steels
6	Chapter 14 continued and Chapter 15 Tool Steels
7	Chapter 16 Stainless Steels
8	Chapter 17 Cast Iron, Cast Steel and Powder Metallurgy Materials
9	Continued Chapter 17 and Chapter 18 Copper and Its Alloys
10	Chapter 19 Aluminum and Its Alloys
11	Chapter 20 Nickel, Zinc, Titanium, Magnesium, and Special Use Metals. Chapter 21 Nanomaterials.
12	Chapter 7 Principles of Polymeric Materials
13	Chapter 8 Polymer Families

14	Chapter 9 Plastic and Polymer Composite Fabrication Processes
15	Chapter 10 Selection of Plastic/polymeric Materials and Chapter 23 Methodology of Material Selection
Final	Final

Notes to Instructors

Process management

1. Introduction
2. The simulation
3. Basic layout
4. Participants
    - Customer
    - Foreman
    - Storekeeper
    - Assembly
    - Testing
    - Repairs
    - Packing
    - Shipping
    - Silent observer
    - Staff
    - Factory owners
    - Instructor
5. Sample schedule
6. Concepts covered by the simulation
    - Process Definition
    - Total Cycle Time
    - Production Time
    - Productivity and Process Improvement
    - Quality
    - Process Mapping
    - Factory Layout
    - First Pass Yield
    - Barriers and Low Hanging Fruit
    - Visual Systems and Process Transparency
    - Benchmarking

- Balanced Score Card
- Cost Analysis and Pricing strategies
- Continuous Improvement Process (CIP)

7. Simulation 1
8. Instructor Input 1
9. Simulation 2
10. Instructor Input 2
11. Simulation 3
12. Instructor Input 4
13. Final Presentations
14. Appendices
    - Appendix 1 – Sample Factory Layout
    - Appendix 2 – Sample Process Mapping
    - Appendix 3 – First Pass Yield
    - Appendix 4 – Barriers low hanging fruit
    - Appendix 5 –Sample Balanced Score Card
    - Appendix 6 – Cost Breakdown

Student Design Project

1. Introduction to Student Project Phase
2. Professions/ Teambuilding and Regulation
    - IT- specialist
    - Mechatronics Engineer
    - Electronics Engineer
    - Electronics Engineer concerning Devices and Systems
    - Systems Informations Technicians
    - Industrial Mechanics
3. Didactical Concept – Action- oriented learning and teaching concept
    - Definition and problems
    - Assembly: self-study and teamwork teacher + student
4. Learning Outcomes
    - Learning tasks and troubleshooting
    - Background phase 1-phase 6
    - Learning with customer order
        - Analysis
        - Planning
        - Realization

        - Monitoring
        - Evaluation
    - Organization (Documentation, Basic Ideas, Open task)
    - Organization of the team
        - Teambuilding/ Reconstruction
        - Optimization of weak points
        - Implementation: Start Phase
        - Team Arrangement
        - Corporation Partners
5. Project Management (definition, planning, accomplishment, completion)
6. Time Schedule
7. Communication
8. Cost Calculation
9. Checking the study achievement
10. Project Management
    - Time Schedule
    - Concept Development
11. Mechanics
    - Technical Construction And Design
    - Production
12. Materials Management and Cost control
    - Cost Estimation
    - Materials Procurement
    - Cost Control During Project

The final project is worth 15-20% of the final grade.