

**ETLS 502 — Manufacturing Processes**

Fall 2009

- Instructor:** Mr. John Walker, CE, MIET, SME  
(612) 962-5764 (UST)  
(612) 962-6419 (UST Fax)  
[j9walker@stthomas.edu](mailto:j9walker@stthomas.edu) (E-mail)
- Time/Location:** Thursday Evenings, 5:30- **9.00** p.m. St. Paul Campus, Binz lower level  
**First class September 3, 2009**
- Required Text:**
- *DeGarmo's Materials and Processes in Manufacturing*, J.T. Black, & R.A. Kosher. Tenth Edition (ISBN 13-978-0470-05512-0). John Wiley and Sons. Ninth Edition is also acceptable.
  - *Product Design for Manufacture and Assembly*, A. Boothroyd, P. Dewhurst and H Knight. Second edition (ISBN 0-8247-0584-X). Marcel Dekker Inc.
  - Duplicated handouts will be distributed on the first night of class.
- Course Description:** An overview of manufacturing processes with the objective of establishing the processes most appropriate to the characteristics and production requirements of the product. Metallurgy is briefly reviewed as a basis for material processing. Many conventional methods of fabrication are covered. Design for manufacturing and assembly techniques will be studied along with assembly methods and flow. Clean rooms and electronic assembly is also covered. Students unfamiliar with manufacturing processes will need to do independent study to determine all of the processes available.
- Course Objectives:** To review and discuss the various manufacturing processes that are available and relate to their characteristics, cost and volume needs, and design requirements. Discuss the design to production transition process (concurrent engineering) and its importance. Discuss processes for mechanical and electronic assemblies. Have the ability to carry out the analysis for efficient assembly design.
- Learning Outcomes:** Upon successfully completing this course the student will be able to:
1. Explain the basic concepts of the structure of iron and steel and its heat treatment.
  2. Able to use a selection criterion for identifying the appropriate process based on shape criteria and material requirements. (MMSE: I, MS6)
  3. Understand the following near net shape processes and be able to evaluate for functional and cost trade off's: Casting, forging, extrusion, powder metallurgy, and injection molding. (MMSE: m, MS6)
  4. Understand the various cutting, forming and machining processes and be able to evaluate for functional and cost tradeoffs: presswork, welding and joining. (MMSE: I, MS6)
  5. Understand the unconventional material removal processes of: EDM, EDWC, Laser Beam, Electron Beam, Electrochemical machining, chemical milling, Ultrasonic machining, Abrasive jet machining and water jet cutting. (MMSE: i, MS6)

6. Discuss the key features and manufacturability and environmental tradeoffs in selection of plating and corrosion protection films, plating and anodizing. (MMSE: k)
7. Have an understanding of the basics of electronic assembly and design. (MMSE: k)
8. Understand the importance of Design To Production Transition. (MMSE: k)
9. Able to demonstrate appropriate assembly techniques. (MMSE: m)
10. Able to apply principles of Design to Manufacturing and Assembly (DFMA) and analyze an assembly using Boothroyd and Dewhurst methodology. (MMSE: m, MS6)

Note: the designators in parentheses refer to the the learning outcomes of the master degrees.(MMSE, MS = MSMS)

**Course  
Methodology:**

The course will start with metal production, heat treatment, metallurgy and testing as a base for the process descriptions and applications. Selected chapters of the course text will be used as a guide augmented by lectures and student presentations. The course will review conventional and non-conventional processes for cutting, joining and forming, clean room use, and mechanical and electronic assembly. (Note- the metallurgy and metal production processes are a review and we will move quickly, students that need more understanding should read the textbook in more detail and use other resources to obtain basic knowledge.). The videotapes will be used as time permits. The reading assignments are designed to provide background to the weekly subjects. They are designated by a chapter and page range. If further designated-skim: only a brief review of the text is required.

*Independent research should be undertaken to gain in-depth knowledge of particular processes.*

**Associated  
Courses:**

ETLS 773 Principles of Micro-Electro Mechanical Systems (MEMS)  
Product Development  
ETLS 771 Materials Engineering

**Major  
Assignments:**

1. There will be a final paper due in the **tenth** week of class (5 point penalty per week or part of week late). This paper should be a case study/research project on a manufacturing process of your choosing (with approval of the instructor). It should include: a description of process, theory, data, comparison of costs, future improvements, projections, applications, etc. The paper should be written in a scholarly way with research into literature and case histories relevant to the topics being discussed not just a regurgitation of existing literature (approximately 10 pages). Graded papers will be returned on the **twelfth** week
2. Each person will be expected to produce a class report for presentation in class. This paper should preferably give the author's personal experience with a process. Oral presentations will be a maximum of 10 minutes. A written report of approximately 4 pages in length is also required for distribution to all class members. This report is to include a bibliography plus copies of any overheads, or Power Point material used in the oral presentation. Note; Presentations will be cut off at the 10 minute point (with a one minute warning).
3. There will be a take-home midterm exam on the **sixth** session covering the subject matter of the first half of the class. (The content will be taken

from the assigned readings, Lecture notes and class sessions) The answers will be collected on the **seventh** week. Answers not returned on this date without prior agreement will grade an "F" - no exceptions.

4. There will be a final exam on the **tenth** session covering the second half of the course, with answers collected on the **eleventh** session. Results will be returned on the **twelfth** session. There will be a group hands on exam for DFMA on the **eleventh** session with results returned on the **twelfth** session.

Note: On the twelfth session all the papers and final exams will be returned together with a grade certificate for the course.

|                        |                     |     |
|------------------------|---------------------|-----|
| <b>Grading Policy:</b> | Research Paper      | 30% |
|                        | Midterm Exam        | 25% |
|                        | Final Exam          | 25% |
|                        | Class Paper         | 15% |
|                        | Class Participation | 5%  |

**Academic Integrity:**

All students are expected to understand and follow the University of St Thomas policies on Academic Integrity. These are described at:

<http://www.stthomas.edu/engineering/graduate/policies>

Exams: Exams are one of the instruments used to evaluate the knowledge gained by an individual student of the class subject matter, and the progress towards meeting the outcomes of the class and the degree. To this end all exams (in class or take home) are intended to represent the effort of the individual and not a group effort unless specifically stated otherwise.

Plagiarism: Plagiarism is not allowed and will result in a minimum of an 'F' for the work. For your reference I have reproduced part of the relevant section of the Student handbook under Academic integrity and dishonesty:

*" Plagiarism - The deliberate adoption or reproduction of ideas or words or statements of another person as one's own without acknowledgment. In every instance, you also must formally acknowledge the written source from which you took the material. (This includes material taken from the World Wide Web and other Internet sources.)"*

**Students with Disabilities**

Qualified students with documented disabilities who may need classroom accommodations for this course should make an appointment with the Enhancement Program – Disability Services office. Students are invited to contact the Enhancement Program – Disability Services about accommodations for this course. Telephone appointments are available to students as needed. Appointments can be made by calling 651-962-6315 or 800-328-6819, extension 6315. You may also make an appointment in person in O'Shaughnessy Educational Center, room 119. For further information, you can locate the Enhancement Program on the web at <http://www.stthomas.edu/enhancementprog>

**Attendance Policy:**

All students are expected to follow the policy described in the student handbook:

**Copyright:**

Permission is granted by the instructor for the future use and/or reproduction by the student of any material presented during the course. Permission is assumed from the student for the future use and/or reproduction (by the instructor or other students attending the course) of the contents of any paper submitted (written or oral) during the course unless written notification to the contrary is received prior to the end of the course.

| <b>Class Outline</b>                       |   |  |
|--|---|--|
| <b>ETLS 502-13 Manufacturing Processes</b> |   |  |
| <b>Fall Semester, 2009</b>                 |   |  |
| <b>Date</b>                                | <b>Topics</b>   | <b>Assignments</b>   |
| September 3<br>Week 1<br>Lecture 1         | 1) Orientation and description of course.<br><br>2) Metallic materials, production & heat treatment.<br><br>Video: "Heat Treatment"   | Ch. 1, p. 14-20 - Basic Manufacturing Processes<br><br>Ch. 3, Nature of Metals & Alloys (skim)<br><br>Ch. 4, Equilibrium Diagrams (skim)<br><br>Ch. 7 - Non Ferrous Metals & Alloys  |
| September 10<br>Week 2<br>Lecture 2 & 4    | 1) Material testing.<br><br>2) Machining, relationship of tolerances & surface finish<br><br>3) Materials & Process Selection<br><br>4) Casting, forging, & extrusion.<br><br>Videos: Videos: (a) "Casting" & "Cold finished steel" - V9045 | Ch. 2, Property of materials (skim)<br>Ch. 6 - Ferrous Metals & Alloys (skim)<br><br><i>Product Design for Manufacture &amp; Assembly</i> - Ch. 2 p. 43-70<br><br>Ch.11 – Fundamentals of Casting p. 283-287, 290-310 (skim)<br><br>Ch.12, Expendable Mold Casting process p. 296-301, 304-323 (skim)                      |
| September 17<br>Week 3<br>Lecture 4 & 5    | 1) Class papers.<br><br>2) Casting, forging, & extrusion. (contd.)<br><br>3) Metal stamping and powder metallurgy<br><br>Videos: (a) "Forging" – TS225.F56<br>"Metal Forming" - TS256.ML1   | Ch. 13, Multiple Use Mold Casting Process p. 325-335 (skim)<br><br>Ch. 16 Bulk Forming Processes p. 381-398  |
| September 24<br>Week 4<br>Lecture 4,5 &6   | 1) Class Papers<br><br>2) Metal stamping and powder metallurgy (contd.)<br><br>3) Joining<br><br>3) Cutting and Material Removal<br><br>Video: "Cutting Tools" VH9243   | Ch. 18 – Powder metallurgy (skim)<br>Ch.16 – Bulk Processes p. 401-417<br><br>Ch. 31 Gas Flame & Arc processes-welding(skim),<br>Ch. 32 Resistance & Solid State Welding Processes (skim),<br><br>Ch. 33 Other Welding Processes, Brazing & soldering p. 891-895, 901-913 (skim).<br><br>Ch. 20, Fundamentals of Machining |

|  |  |  |
|--|--|--|
|  |  | p.523-533 (skim)<br>Ch. 22, Cutting Tools and Fluids p. 560-581 & 591-592  |
| October 1<br>Week 5<br>Lecture 6 & 8       | 1) Class Papers<br>2) Unconventional Material Removal<br>3) Assembly Techniques<br>4) Introduction –Design for Manufacturing and Assembly (DFMA)<br><br>Video: Water Jet Cutting | Ch. 19 Non traditional machining processes p.484-492, 504-520 (skim)<br><br><i>Product Design for Manufacture &amp; Assembly</i> Chapter 3 |
| October 8<br>Week 6<br>Lecture 10          | 1) Class papers)<br>3) DFMA<br><b>Midterm Exam</b> Take-Home Midterm Course Evaluation   | <i>Product Design for Manufacture &amp; Assembly</i> Chapter 3   |
| October 15<br>Week 7<br>Lecture 3          | 1) Plating & Corrosion<br>Guest speaker: Mike Mc Chesney<br>2.) <b>Collect Midterm Exam</b>  |  |
| October 22<br>Week 8<br>Lecture 8          | 1) Class papers.<br>2) Review Midterm Exam<br>3) DFMA<br>4) Video: IBM Pro printer   | <i>Product Design for Manufacture &amp; Assembly</i> Chapter 3   |
| October 29<br>Week 9<br>Lectures 8,10 & 11 | 1) Class paper<br>3) Clean Rooms<br>4) Metrology and Inspection<br>5) DFMA   | <i>Product Design for Manufacture &amp; Assembly</i> Chapter 3<br><br>Ch. 10, Measurement and Inspection (skim)                            |
| November 5<br>Week 10<br>Lecture 8 & 12    | 1) Class papers.<br>2) Electronic assembly.<br>3) Video: "How to avoid static from all sides" – TK7835.H69<br>4) <b>Take home final exam</b><br>5) <b>Research paper due.</b>    | Ch. 19.2 Chemical Machining Processes p. 493-504 (skim)  |

|                        |   |  |
|------------------------|---|--|
| November 12<br>Week 11 | 1) <b>Group Exam for DFMA</b><br>2) <b>Take home exam due</b><br><br>Final Course/Instructor evaluations. |  |
| November 19<br>Week 12 | 1) Exam review.<br><br>2) Course wrap-up.   |  |

**Please note:** Weeks 1,2,3,5,6,9 & 10 - Book reference by chapter for *Materials & Processing in Manufacturing* – J.T.Black & RA Kohser

Weeks 2, 6, 7, 8, & 9 - Book reference is in italics: *Product Design for Manufacture & Assembly* - Boothroyd and Dewhurst.