



Detailed Course Plan

096310 (MfgE Mech.) Manufacturing Processes

Instructor

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Learning Objectives

This course design to introduce the basics of manufacturing processes technology and manufacturing properties of metals. The course will cover the basic Fundamentals of; the mechanical behavior of materials; Metal Casting technology; Bulk Deformation Processes; Sheet-Metal Forming Processes; Metal Cutting and Machine Tools; Surface Finishing and processes capabilities.

1. Describing the fundamental aspects of the mechanical behavior of materials during deformation. Individual topics described are deformation mode, stresses, forces, and work of deformation, hardness toughness and ductility.
2. Describing the basic bulk deformation processes for metal: forging, rolling, extrusion, and drawing of rod and wire.
3. Understanding the principles and the technology of wide variety of Sheet-Metal Forming Processes: Deep drawing, Sheet metal bending and shearing.
4. Exploring cutting operations and the main aspects of cutting tool technology
5. Explaining the main aspects of casting processes and the related important tools necessary in Foundry
6. Introducing the principles of surface roughness and process capabilities.

Prerequisite

- **Strength of Material**
- **Properties of engineering materials**

Course Duration

One semester of 16 weeks. 3 Weekly Hours.

Office Hours

Lectures Sun; Tue; Thu: 13:00 - 14:00.

Office hours: Mon; Wed: 13:00 - 14:00, and whenever am available.

Office: IE Dept. (C. 212).

Learning/Teaching Methods Lectures and Teaching tools include PPT slides, handouts and case studies analysis.

Topics Schedule

Week	Hours	Subject	Ref.
1	12	- <i>Introduction and Overview of Manufacturing.</i> - <i>Mechanical Properties of Materials.</i>	Chapter 1 + 2
2		Fundamentals of Metal Casting	
3		<ul style="list-style-type: none"> - <i>Overview of Casting Technology</i> <ul style="list-style-type: none"> - <i>Operations Flow for Producing a Casting.</i> - <i>Casting Processes and Casting Terminology.</i> - <i>Classification of Molding and Castings Processes.</i> - <i>Heating the Metal</i> <ul style="list-style-type: none"> - <i>Heating and Melting of the Metal.</i> - <i>Pouring the Molten Metal.</i> - <i>Engineering Analysis of Pouring.</i> - <i>Fluidity.</i> - <i>Solidification and Cooling</i> <ul style="list-style-type: none"> - <i>Solidification of Metals.</i> - <i>Solidification Time.</i> - <i>Shrinkage.</i> - <i>Directional Solidification.</i> - <i>Casting Design,</i> <ul style="list-style-type: none"> - <i>Risering</i> - <i>Gating</i> - <i>Pattern design</i> 	
4		Metal Casting Processes	
5	3	- <i>Sand casting.</i> <ul style="list-style-type: none"> - <i>Patterns and Cores.</i> - <i>Molds and Mold Making.</i> - <i>The Casting Operation.</i> 	Chapter 10
6	3	- <i>Other Expandable Mold Casting Processes.</i> <ul style="list-style-type: none"> - <i>Shell Molding.</i> - <i>Vacuum Molding.</i> - <i>Expandable Polystyrene Process.</i> - <i>Investment Casting.</i> - <i>Plaster-Mold and Ceramic-Mold Casting.</i> 	Chapter 11
7	3	<ul style="list-style-type: none"> - <i>Permanent Mold Casting Processes.</i> <ul style="list-style-type: none"> - <i>The Basic-Permanent Mold Process.</i> - <i>Variations of Permanent-Mold Castings.</i> - <i>Die Casting.</i> - <i>Centrifugal Casting.</i> - <i>Foundry Practice.</i> <ul style="list-style-type: none"> - <i>Furnaces.</i> - <i>Pouring, Cleaning and Heat Treatment.</i> - <i>Casting Quality.</i> - <i>Metals for Casting.</i> - <i>Product Design Considerations.</i> 	

9	3	<p><i>Bulk Deformation Processes</i></p> <p><i>- Forging.</i></p> <ul style="list-style-type: none"> - <i>Classifications of Forging Processes.</i> - <i>Open Die Forging (Upsetting)</i> - <i>Deformation, Barreling and Grain Flow Lines</i> - <i>Forces and Work in Forging</i> - <i>Impression-Die Forging</i> - <i>Closed-Die Forging</i> - <i>Miscellaneous Forging Operations</i> 	Chapter 14
10	3	<p><i>Rolling</i></p> <ul style="list-style-type: none"> - <i>Mechanics of Rolling: State of Stress in Rolling and Roll Pressure; Neutral point; Front and Back Tension. Roll Forces; Roll Torque and Power; Forces in Hot Rolling; Friction; Roll bending and flattening, Spreading of Rolled Metals</i> - <i>Miscellaneous Rolling Operations; Shape Rolling. Ring Rolling, Thread and Gear Rolling, Rotary Tube; Piercing, and Tube Rolling.</i> - <i>Defects in Rolling; Surface Defects and Structural Defects</i> <p><i>Extrusion,</i></p> <ul style="list-style-type: none"> - <i>Miscellaneous Extrusion Operations. Direct Extrusion; Indirect Extrusion; Cold Extrusion; Impact Extrusion; Hydrostatic Extrusion</i> - <i>Mechanics of Extrusion; Ideal Deformation; Ideal Deformation and friction; Actual Forces; Optimum Die angle; Strain rate in Extrusion; Forces in hot Extrusion.</i> - <i>Defects in Extrusion; Surface Cracking; Extrusion Defects. Internal Cracking.</i> 	Chapter 13

		Rod and wire drawing	
11	3	<ul style="list-style-type: none"> - Rod and Wire Drawing Operations; Drawing of Rods; Drawing of Wires; Drawing Of Flat Strip; Drawing of tubes - Mechanics of Rod and Wire Drawing: Ideal Deformation; Ideal Deformation and friction; Redundant Work Of Deformation; Die Pressure; drawing At Elevated Temperature; optimum Die angle; maximum Reduction Per Pass - Defects In Extrusion 	Chapter 15
12	3	<p>Sheet-Metal Forming Processes</p> <ul style="list-style-type: none"> - Bending - Forces in bending - Common Bending Operations; bress-brake Forming; beading; flanging; dimpling; hemming; roll Forming; tube bending <p>Deep drawing</p> <ul style="list-style-type: none"> - Introduction; What is Deep Drawing; Shallow Drawing; Parameters of Deep Drawing; Pure Drawing; Stretching; Wrinkling; Ironing - Drawn Height and Plastic Work - Deep Drawability; Limiting Drawing Ratio; Normal Anisotropy; Planner anisotropic Materials - Earing. - Maximum Punch Force 	Chapter 15
13	3	<p>Shearing process</p> <ul style="list-style-type: none"> - Introduction; Description of Shearing Process; Variables in the shearing process; Features of Sheared Surfaces; Clearance Between Punch and Die; Maximum Punch Force - Shearing Operations; Punching and Blanking; Die Cutting; Fine Blanking; Slitting; Steel Rules; Nibbling - Shearing Dies; Compound Dies; Progressive Dies - Stretching, Bulging - Formability of sheet metal 	Chapter 16

		<p><i>Cutting processes and Machine tools</i></p> <ul style="list-style-type: none"> - <i>Cutting processes and Machine tools for producing round shapes</i> <ul style="list-style-type: none"> - <i>Lathes, lathe operations and tools: lathes; MRR; CNC etc.</i> - <i>Boring and boring machines</i> - <i>Drilling, drilling Operations and tools: drills; operations; MRR.</i> - <i>Reaming and reamers</i> - <i>Tapping taps</i> - <i>Cutting processes and Machine tools for producing various shapes</i> <ul style="list-style-type: none"> - <i>Milling Operations</i> - <i>Planning and planners</i> - <i>Shaping and shapers</i> - <i>Broaching and broaching machines</i> - <i>Sawing and saws</i> 	Chapter 22	
14 15	3 3		Chapter 23	

Textbook

Groover et al., fundamental of modern manufacturing, 3rd edition, John Wiley & Sons, Inc.

References and Websites

1. Kalpakjian et al., Manufacturing Processes for engineering Materials, fourth edition, Prentice-Hall
2. Wakil, S.D.El, Processes and design for manufacturing, 3rd edition, PWS Publishing Company.
3. Oswald P.F. and Munoz, J., Manufacturing processes and Systems, 10th edition, John Wiley and Sons.
4. Callister, Materials Science and engineering an introduction, 3rd edition, John Wiley & sons.

Assessment

Mid Exam	30%	to be determined in class
Project	10%	
Quizzes and	10%	
Final Exam	50%	to be determined in class

Make up exam is not allowed with out legal justification.