

Manufacturing Processes 1

Course Data Catalogue

IE 252: Manufacturing processes -1-

3(3,1,1)

Catalog Data

Understanding engineering materials and processing parameters that influence design considerations, product quality, and production costs; stress, strain analysis and mechanical properties of materials applied to metal forming processes; sheet metal forming, deep drawing, stretch forming and bending; drawing, forging, rolling and extrusion processes; basic casting techniques; Welding proces.

Prerequisite
Co requisite

IE251

Manufacturing Processes 1

Course Data Catalogue

Level	5
Textbook	* <i>Manufacturing Processes for Engineering Materials</i> , 5th Ed., S. Kalpakjian and S. Schmid, Upper Saddle River, NJ: Prentice Hill (2008).
Reference	* Manufacturing Engineering Processes, L. Alting, Marcel-Dekker. * Manufacturing Engineering Processes اختيار العمليات الهندسيه للتصنيع By Dr Ali M Alsamhan and Prof Saied Darwish, Research center college of engineering. Project 50/426. June 2006.
Learning Objectives	To review and discuss the various manufacturing processes that are available and relate to their characteristics, cost and volume needs, and design requirements.

8/31/2014

Course Catalogue Data:
Manufacturing Process IE252

Manufacturing Processes 1

Course Data Catalogue

Topics (classes)

CLASS WORK

- | | | |
|----|-------------------------------------|-----------|
| 1. | Morphology of manufacturing process | 2 classes |
| 2. | Fundamental theory of metal forming | 7 classes |
| 3. | Bulk Metal forming processes | 7 classes |
| 4. | Welding and welding processes | 7 classes |
| 5. | Casting and casting processes | 7 classes |
| 6. | Sheet metal forming processes | |

Lab. work

EXPERIMENTAL WORK

- | | | |
|----|--|-------|
| 1. | Testing material properties – compression test | 1 Lab |
| 2. | Casting processes and sand casting | 1 Lab |
| 3. | Sand casting tests | 2 Lab |
| 4. | Welding processes | 1 Lab |
| 5. | Sheet metal forming processes | 1 Lab |
| 6. | Extrusion | 2 Lab |

8/31/2014

Course Catalogue Data:
Manufacturing Process IE252

Manufacturing Processes 1

Course Data Catalogue

Computer Usage Learning outcomes

- Excel program and analysis of experimental data
- 1 Understand basic product design and manufacturability. [c]
 - 2 Describe basic materials properties, behaviors, and failure modes and their relevance to manufacturing processes. [c]
 - 3 Describe selected metal forming operations and calculate the associated force and energy requirements. [c]
 - 4 Describe molding and casting processes and perform metal casting molds design.[c]
 - 5 Describe welding parameters, effects and quality control of welding joints.[c]
 - 6 Experimental metal forming processes [b]

**COURSE
OUTCOMES**

Manufacturing Processes 1

Course Data Catalogue

Estimated	Engineering Science: 2 credit hours (50%)
Category Content	Engineering Design: 2 credit hour (50%)
Prepared by	Dr Ali M Alsamhan Room 2A112
Preparation Date	Dec 2009 – Updated Aug, 2014
Instructor	Prof. Dr Ali M Al Samhan, Room 2A112, http://fac.ksu.edu.sa/asamhan

**COURSE
INSTRUCTOR**

8/31/2014

Course Catalogue Data:
Manufacturing Process IE252

(5)

Manufacturing Processes 1- Reference

Course Data Catalogue

* Manufacturing Engineering Processes اختيار العمليات الهندسيه للتصنيع
By Dr Ali M Alsamhan and Prof Saied Darwish, Research center college of
engineering, Project 50/426, June 2006.

UPDATED
AUG, 2014

* Manufacturing Engineering Processes اختيار العمليات الهندسيه للتصنيع
By Dr Ali M Alsamhan and Prof Saied Darwish, Research center college of engineering, Project 50/426, June 2006.

Preface	II
Preface (<i>Arabic</i>)	III
Content	VI
Acknowledgment	VII
 CHAPTER ONE: Morphologic Process Model	
1.1 Morphological manufacturing process.	1.2
1.2 Material flow system	1.4
1.2.1 Types of material flow	1.4
1.2.2 State of material	1.5
1.2.3 Basic process	1.5
1.2.4 Illustrated examples	1.6
1.3 Energy flow system.	1.7
1.3.1 Energy flow for mechanical basic process	1.7
1.3.2 Energy flow in thermal basic processes	1.8
1.3.3 Energy flow for chemical basic processes	1.9
1.4 Information flow system.	1.9

* Manufacturing Engineering Processes اختيار العمليات الهندسيه للتصنيع

By Dr Ali M Alsamhan and Prof Saied Darwish, Research center college of engineering, Project 50/426, June 2006.

CHAPTER TWO: Material Properties and Manufacturing Materials

2.1 Material properties	2.2
2.2 Importance of material properties in manufacturing	2.2
2.2.1 Forming from liquid state	2.3
2.2.2 Forming from solid state	2.4
2.2.3 Joining processes	2.6
2.3 Effect of manufacturing processes on material properties	2.6
2.4 Strength-increase techniques in metals	2.6
2.4.1 Hardening by solid-state phase transformation	2.6
2.4.2 Strain hardening	2.7
2.4.3 Dispersion hardening	2.8
2.5 Classification of materials	2.8
2.6 Ferrous metals	2.9
2.6.1 Steel classification based on the amount of alloying elements.	2.10
2.6.2 Steel classification based its application.	2.10
2.7 Cast Iron	2.11
2.8 Nonferrous metals	2.12
2.8.1 Aluminum/aluminum alloys	2.12
2.8.2 Copper/copper alloys	2.13
2.9 Plastics	2.13
2.9.1 Design considerations in plastic materials	2.14
2.9.2 Assigning plastic material for specific applications	2.15
2.10 Ceramics	2.15
2.11 Glasses	2.15
2.12 Composite material	2.15

* Manufacturing Engineering Processes اختيار العمليات الهندسيه للتصنيع
By Dr Ali M Alsamhan and Prof Saied Darwish, Research center college of
engineering, Project 50/426, June 2006.

CONTENT

CHAPTER THREE: Principle of Metal Forming Theory

3.1 Experimental stress-strain flow curve.	3.1
3.2 Nominal and true stresses and strains.	3.3
3.3 Volume constancy phenomena in metal forming processes.	3.5
3.4 Plastic tensile instability and necking condition.	3.6
3.5 Analytical stress-strain flow curves.	3.7
3.6 Yielding criteria.	3.10
3.7 Plane strain and plane stress conditions.	3.12
3.8 Work and energy method application in metal forming processes.	3.14

* Manufacturing Engineering Processes اختيار العمليات الهندسيه للتصنيع

By Dr Ali M Alsamhan and Prof Saied Darwish, Research center college of engineering, Project 50/426, June 2006.

CONTENT

CHAPTER FOUR: Power Estimation in Strip Rolling Process

4.1 Work and energy principle for estimating power on metal forming processes.	4.2
4.2 Slap rolling.	4.2
4.2.1 Rolling technology.	4.2
4.2.2 Flat rolling load estimation.	4.8
4.2.3 Effective strain and stress for strip rolling.	4.8
4.2.4 Rolling load and torque estimation.	4.9

* Manufacturing Engineering Processes اختيار العمليات الهندسيه للتصنيع

By Dr Ali M Alsamhan and Prof Saied Darwish, Research center college of engineering, Project 50/426, June 2006.

CONTENT

CHAPTER FIVE: Power Estimation in Extrusion and Wire/rod Drawing

5.1 Extrusion	5.2
5.1.1 Extrusion Technology.	5.2
5.1.2 Extrusion Processes.	5.3
5.1.3 Load and power estimation	5.5
5.2 Wire and rod drawing.	5.7
5.2.1 Wire and rod drawing technology.	5.7
5.2.2 Wire-rod load and power estimation	5.9

* Manufacturing Engineering Processes اختيار العمليات الهندسيه للتصنيع

By Dr Ali M Alsamhan and Prof Saied Darwish, Research center college of engineering, Project 50/426, June 2006.

CONTENT

CHAPTER SIX : *Joining Processes of Solid Materials*

6.1 Joining technology.	6.2
6.2 Joining techniques based on cohesion and/or adhesion principles.	6.3
6.3 Fusion welding	6.4
6.3.1 Fusion welding based on electric energy (arc welding).	6.5
6.3.2 Fusion arc welding process.	6.6
6.3.3 Fusion welding based on chemical energy (gas welding).	6.7
6.4 Pressure welding.	6.8
6.4.1 Cold welding.	6.8
6.4.2 Resistance welding.	6.8
6.4.3 Resistance welding processes.	6.8
6.4.4 Other types of pressure welding	6.9
6.5 Joining processes based on filler material of $T_f < T_w$ (Brazing, soldering and adhesive bonding)	6.10
6.5.1 Brazing, soldering and braze welding.	6.10
6.5.2 Adhesive bonding.	6.11

* Manufacturing Engineering Processes اختيار العمليات الهندسيه للتصنيع

By Dr Ali M Alsamhan and Prof Saied Darwish, Research center college of engineering, Project 50/426, June 2006.

CONTENT

CHAPTER SEVEN: Casting and Casting Operations

7.1 Introduction	7.2
7.2 Characteristics of major casting processes.	7.2
7.3 Melting and composition control in casting.	7.4
7.4 Classification of mostly used industrial melting furnaces.	7.5
7.4.1 Cupola furnace.	7.6
7.4.2 Open-hearth furnace	7.6
7.4.3 Rotary furnace.	7.6
7.4.4 Crucible furnace.	7.6
7.4.5 Arc furnace.	7.6
7.4.6 Induction furnace.	7.6
7.4.7 Resistance furnace	7.5
7.5 Charge balance in melting furnaces	7.7
7.6 Charge balance in Cupola furnace.	7.7

* Manufacturing Engineering Processes اختيار العمليات الهندسيه للتصنيع
By Dr Ali M Alsamhan and Prof Saied Darwish, Research center college of
engineering, Project 50/426, June 2006.

CHAPTER SEVEN: Casting and Casting Operations

7.7 Casting processes	7.9
7.7.1 Green sand casting.	7.9
7.7.2 Shell sand casting.	7.11
7.7.3 Investment casting.	7.12
7.7.4 Permanent mold casting	7.14
7.7.4.1 Gravity mold casting.	7.14
7.7.4.2 Low pressure casting.	7.16
7.7.4.3 High pressure or die casting.	7.17
7.7.5 Centrifugal casting.	7.18
7.8 Pouring system in mold design	7.19
7.9 Riser consideration in mold design.	7.19
7.10 Simplified riser design based on solidification time.	7.21

* Manufacturing Engineering Processes اختيار العمليات الهندسيه للتصنيع

By Dr Ali M Alsamhan and Prof Saied Darwish, Research center college of engineering, Project 50/426, June 2006.

CONTENT

CHAPTER EIGHT: Sheet metal deep drawing and bending processes

8.1 Deep drawing and Stretch drawing.	8.1
8.2 Deep drawing process	8.3
8.2.1 Double action deep drawing process	8.3
8.2.2 Single action deep drawing process	8.3
8.2.3 Counter drawing or reverse drawing process	8.6
8.2.4 Calculation of the blank size	8.7
8.2.5 Calculation of drawing ratio	8.11
8.2.6 Drawing force calculation	8.12
8.2.7 Blank hold force calculation	8.13
8.2.8 Drawing energy calculation	8.14
8.3 Sheet metal shearing process	8.15
8.3.1 Press work for shearing	8.16
8.4 Sheet metal Bending Process	8.19
8.4.1 Bending radius and bending angle on press brake	8.21

* Manufacturing Engineering Processes اختيار العمليات الهندسيه للتصنيع

By Dr Ali M Alsamhan and Prof Saied Darwish, Research center college of engineering, Project 50/426, June 2006.

CONTENT

CHAPTER EIGHT: Sheet metal deep drawing and bending processes

8.4 Sheet metal Bending Process	8.19
8.4.1 Bending radius and bending angle on press brake	8.21
8.4.2 Spring-back effect in bending	8.22
8.4.3 Estimating the blank lengthy for bents	8.24
8.4.4 Estimating bending force and energy for V-bend sections	8.26

* Manufacturing Engineering Processes اختيار العمليات الهندسيه للتصنيع
By Dr Ali M Alsamhan and Prof Saied Darwish, Research center college of
engineering, Project 50/426, June 2006.

END OF CONTENT