

King Fahd University of Petroleum & Minerals
MECHANICAL ENGINEERING DEPARTMENT
ME-406 Manufacturing and Design

Catalogue Description: (3-0-3)

Dimensional metrology, basic statistical concepts in characterizing the variability of measurements, and introduction to statistical manufacturing process control. Process capability analysis. Design considerations in manufacturing. Abrasive machining and non-traditional metal removal processes, CAD/CAM - Numerical Control machining. Powder metal processing. Manufacturing with Polymers, Rapid Prototyping. Design for Manufacturability and Economics of Manufacturing. Design and Manufacturing Case Studies.

Status in Curriculum: Mandatory for AME, Elective for ME

Pre-requisites:(ME 322 and ME323) or ISE 322.

Prerequisites by Topics:

1. Introduction to casting, welding, forging and machining processes
2. Familiarity with design software such as Solid works.
3. Working knowledge of a spreadsheet, such as Excel.

Textbook:Mikell P. Groover, Principles of Modern Manufacturing, Fifth Edition, John Wiley and Sons, 2013

References: .

1. Kalpakjian, S., Manufacturing Processes for Engineering Materials, 5TH edition, Addison-Wesley, 2009
2. E. P. DeGarmo, J. T. Black, and R. A. Kosher, Materials and Processes in Manufacturing, 8th Edition, Prentice Hall.
3. Douglas C. Montgomery, George C. Runger, Norma F. Hubele. Engineering Statistics, 5th Edition **Wiley**

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Goals:

This course is intended to both introduce students to discrete part manufacturing processes, and process design to provide them with the skills required for part analysis, process selection, and product fabrication while keeping in mind the economical, technological, and safety aspects

1. The course provides a specialized understanding of conventional and non- conventional material removal processes, rapid prototyping, and processing plastics, and metal powders.
2. The course highlights the influence of process variables on the quality of the products and economy of the processes.
3. The course enable the students to design detailed process plans for the manufacturing processes or to develop detailed product designs by applying design for manufacturing (DFM) concepts.
4. The course also introduces students to manufacturing automation and computer numerical control (CNC) systems through project/exercises based upon knowledge gained by students in accompanying mandatory lab course ME 407 (self-study).
5. The course provides a basic understanding of engineering statistics and process control through use of statistical software and linear regression to develop manufacturing process models.

Course Outline (Lecture Topics):

1. Dimensional metrology : measurements and inspection (2-Lectures) (Handouts -slides set 1 /Chapters 6 and 37)
2. Engineering Statistics and Statistical Quality Control-Introduction to basic engineering statistics, graphical representation of engineering data ,basic probability and probability distributions explained through manufacturing related examples , manufacturing process variability and quality control through use of statistical software (**STATGRAPHICS/EXCEL**) for problem solving, decision making about mean and variance (Hypothesis testing single parameter)and the differences of mean and variances (Two parameters testing),and linear regression to develop simple manufacturing process and economic model .(Reference Book –Statistics for Engineers- by Montgomery (15 Lectures) **EXAM 1 Project 1 A Assigned**
3. Powder metallurgy (5 Lectures) (chapter 12)
4. Processing of polymers and plastics.(7 Lectures) (chapters 10-11) **Project 1 b Assigned**
5. Self-study review of conventional metal cutting, including turning, drilling, milling, and broaching. (Brief introduction and self-study to review ME322 contents handout s)
6. Grinding.(3 Lectures) ((chapters 21) ,**EXAM 2.**

7. Nontraditional material removal processes .(3-Lectures) (chapters 22
8. Design aspects of all manufacturing processes discussed in ME322 and ME406 which are not discussed as a part of coverage of that specific process. (Handout), . Design for Manufacturability-Guidelines (DFM). (2 Lectures))
9. Manufacturing Economics (chapter 1, Section 1.5. pp22 to 27) (1 Lecture)
Economics and Product Design Considerations in Machining (2 Lectures) (Chapter 20)

Projects due in 14th week of the semester.

10. Some other useful Manufacturing Economics Models from handouts 2 Lectures)
11. Overview of manufacturing automation CNC based upon knowledge gained in ME407 (self-study 1 Lecture) (selected material from chapters 34-35) **EXAM FINAL**

Design Activities/Projects:

Engineering Statistics Project- Computer Aided Problem Set-Project 1A-(8 points)
Manufacturing Economics and Design Project- Computer Aided Problem Set-Project 1 B –(7 points)
Project assigned to be submitted back by the students in 14th week of the semester.

Computer Usage:

Most of the data analysis and Engineering Statistics Topics topics and related homework and assignments will require the use of any of the well-known spreadsheet software, such as Excel. Linear and Multiple regression will be facilitated through STATGRAPHICS and Excel. Design project will need use of CAD software –Solid Works

Assessment Tools:

- i- Two Mid-term Examinations(20 points each)
- ii- Homework (5 points)/Project Assignments (15 points)
- iii- Quizzes (10 points)
- iv- Final Exam (30 points)

Course Learning Outcomes:

After taking this course, students will be able to

- I- Develop an understanding of the effect of process parameters on machining (Milling, Grinding) variables such as cutting forces, tool life and surface finish..
- II- Understand various plastics processing technologies, and know their applications, including introduction to Rapid Prototyping Technologies
- III- Understand metal powders processing technologies, and know their applications.
- IV- Understand basic statistics and application of statistical tools in quality control and assurance requirements of a manufactured product.
- V- Understand basic linear regression to develop empirical manufacturing models..
- VI- Understand various design aspects for manufacturability and design issues relevant to various manufacturing processes.
- VII- Understanding economics and productivity aspects of Manufacturing Processes and develop ability to determine optimal process parameters to meet desired process and product outputs.

Course Learning Outcomes mapped to Student Outcomes:

Student Outcomes	a	b	c	d	e	f	g	h	i	j	k
Course-to-Student outcome mapping	I, II, III,IV, V		II,,III IV,V VI,	II,,III IV,V VI,	II, III IV, V,VI		VI,VII			IV,V VI, VII	IV,V VI, VII
Emphasis*	S		S		S		M			L	M

* L:: Little/None M: Moderate S: Strong

Status of Continuous Improvement review of this Course:

Date reviewed: March 9th, 2015
Prepared by: Dr. Anwar K. Sheikh

Reviewed by: Dr. Numan Abu Dheir
Date prepared: March 6th, 2015