

Advanced Manufacturing and Materials Processing, Summer 2025
Randolph College
Engineering Department

Instructor

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Brief Teaching Philosophy Education is a life-long pursuit and involves more than just books and numbers or letters on paper or board. I believe that the key to receiving and providing good education involves the process of learning to synthesize books, numbers, and letters with the nature and substance of everyday life. I like my teaching to address these such questions as:

1. How can a design and manufacture class be a tool for students in design projects?
2. How can they use this tool to make products for their employers and society?
3. How will research show a student how to advance science and make the world a better place to live?

This type of approach connects learning and living that I take with me into the classroom. Students should not only know what they are doing, but they should also know why and how.

Textbooks and Materials

Fundamentals of Modern Manufacturing Materials Processes and Systems 4th Edition,
M.P. Groover

Material Engineering Technology, Sixth Edition, Serope Kalpakjian Machining
Technology Machine Tools and Operations, H A Yousf Composite Materials Design and
Applications, Third Edition, Daniel Gay

Required readings and articles will be linked in weekly content modules or available through the Library Resources tab on the course site.

Course Introduction

An introduction to methods of transforming materials from raw to useful products including material responses, thermal and mechanical processing of metals, polymers, composite materials, and additive manufacturing techniques.

Course Goals

The ultimate aim of this course is for you to be able to make engineering comparative choices about the best manufacturing technique to execute based on the identification, analysis, and evaluation of available materials and processes.

Learning outcomes

1. An ability to identify, formulate, and solve complex engineering problems by applying engineering, science, and mathematics principles.
2. An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.
3. An ability to communicate effectively with a range of audiences.
7. An ability to acquire and apply new knowledge using appropriate learning strategies.

Learning objectives

By the end of this course, students will be able to:

- Understand the role and impact of manufacturing in society and the design process.
- Analyze material behavior through stress-strain analysis, hardness, and mechanical property evaluation.
- Select and design appropriate casting, forming, machining, and joining processes for various materials.
- Understand and calculate forces, pressures, and power needs for processes like forging, rolling, and drawing.
- Evaluate polymer and composite behavior, processing methods, and structural characteristics.
- Describe powder metallurgy and sintering processes.
- Apply knowledge of additive manufacturing and rapid prototyping techniques.
- Interpret and apply manufacturing principles to real-world engineering problems.

Assessment and Grading Summary

- **Assignments:** Weekly assignments involve practical calculations related to each week's manufacturing topic. Emphasis is on understanding the process, not just the correct answer.
- **Quizzes/Activities:** Short quizzes or activities in each section test understanding of key concepts.
- **Exams:** Two exams based only on previously graded/assigned material.
- **Late Work:** Deducted 20% per day if submitted late.

Assignments – 25%

Exam 1 – 25%

Final Exam – 25%

Project – 10%

Quizzes – 15%

Course Schedule (Topics Overview)

- Introduction to Manufacturing
- Mechanical Properties of Materials
- Metal Casting and Glass Working
- Polymer Processing
- Composite Materials and Polymer Matrix Composites
- Powder Metallurgy and Ceramics
- Metal Forming and Sheet Metalworking
- Machining, Tooling, and Heat Treatment
- Rapid Prototyping