

SYLLABUS
MSE 4210 – Manufacturing Processing
Spring, 2025
Instructor:

Course Description:

This course examines the fundamental principles of manufacturing which underlie the fabrication of engineering components. Topics covered may include thin-film growth (electronic, metallic, ceramic, and polymeric materials), casting and joining (welding) of metals, surface measurement and wear (tribology), machining (milling, turning, drilling), additive manufacturing, and deformation processing, materials design, and selection.

Credits: 3 credits of math/science, engineering; 3 contact hours per week.

Prerequisite: MSE 2090 or permission of the instructor

Textbooks and other required materials: Course Textbook: Manufacturing Processes for Engineering Materials, >5th edition. Serope Kalpakjian, Steven Schmid, ISBN-13: 978-0-13-227271-1, Supplemental: A User's Guide to Vacuum Technology, John F. O'Hanlon, The Materials Science of Thin Films, Milton Ohring.

Degree Program Impact: Fulfills MSE Elective

Schedule: T/R 1400-1515, Jesser 171

Learning Objectives and Program Outcomes:

Outcomes Mapping

SO7: An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

- **Students take initiative for their learning**
 - **Appropriate learning strategies can include courses, research, interviewing experts – whatever is appropriate for the task**
 - **Meant to be broad – this can be approached in many ways**
1. Acquire new knowledge of materials processing science and techniques
 - a. Processing knowledge sub-indicator 1
 - b. Processing knowledge sub-indicator 2
 - c. Processing knowledge sub-indicator 3
 2. Apply concepts from MSE core courses, and foundational math/science courses, to materials processing.
 - a. Apply core knowledge of thermo and kinetics to processing
 - b. Apply core knowledge of structure and defects to processing
 - c. Apply core knowledge from chemistry, physics and applied math to materials processing.
 3. Develop sound learning strategies that enable future growth.

General Course Topics:

1. Introduction to Materials Processing and Manufacturing: Overview
 - Casting Operations
 - Product Design Specifications
 - Design For Manufacture
 - Processes: Casting, Forming, Cutting, Joining
 - Materials Selection
 - Phase Diagrams and Properties
 - Surfaces and Applications
 - Films and Coatings
 - Value Added Products
 - Economic Impacts
2. **Thin Films Processing and Growth**
 - Vacuum Science
 - Deposition Techniques
 - Film Formation and Microstructure
3. **Casting**
 - Introduction to Casting
 - Solidification of Metals
 - Solidification of Alloys
 - Fluid Flow and Heat Transfer
 - Shrinkage and Porosity
 - Casting Alloys
 - Casting Processes
4. **Joining**
 - Joining
 - Joint Strength
 - Metal Joining Techniques
 - Brazing
 - Oxyfuel Gas Welding (oxyacetylene)
 - Arc Welding
 - Gas Metal Arc Welding (MIG)
 - Gas Tungsten Arc Welding (TIG)
 - Electron / Laser Beam Welding
 - Heat Generation and Transfer in Welding
 - Fusion Weld Characteristics
5. **Surfaces and Tribology**
 - Surface Structure and Properties
 - Surface Texture and Roughness
 - Tribology
 - Surface Treatments and Coatings
 - Engineering Metrology
 - Dimensional Tolerances
 - Testing and Inspection
 - Quality Assurance

6. Machining

- Introduction
- Machining Processes: Type, Geometry, and Operation
- Deformation and Metal Flow: Chip Formation
- Fluids
- Forces
- Temperatures
- Tool Wear
- Machinability
- Tool Inserts
- Manufacturing Rates and Design for Machining

Grading Criteria

Participation (5%)

Attendance

Asking/Answering questions – if you have one, ask; if asked, kindly respond.

Course evaluations – completely anonymous, participation recorded

Short (simple) quizzes will be given at the beginning of many lectures.

Test comprehension of previous lectures; Assess preparation (reading) for current

Individual or group efforts

Homework (15%)

My philosophy is that science and engineering is learned through understanding the fundamentals, proper study habits, and practice. Homework performance can help to hold your grade up after a poor exam performance.

Use sufficient figures and units and show all work, place final answers in box.

Discussion of problem concepts is acceptable unless specifically noted otherwise.

When applicable pledge HWs and note the names of people with whom you have consulted.

Late assignments will not be graded unless of mitigating circumstances which do occur.

Term Project, Written Assignment (20%)

Three Exams (60%)

In-class or timed take-home, honor code in effect, pledged.

Use appropriate significant figures and units.

Show all work, place final answers in box.

Additional Course Information

The UVA Honor Code

<https://honor.virginia.edu/statement>

I trust every student in this course to fully comply with all of the provisions of the University's Honor Code. By enrolling in this course, you have agreed to abide by and uphold the Honor System of the University of Virginia, as well as the following policies specific to this course.

All graded assignments must be pledged unless otherwise stated.

All suspected violations will be forwarded to the Honor Committee, and you may, at my discretion, receive an immediate zero on that assignment regardless of any action taken by the Honor Committee.

Please let me know if you have any questions regarding the course Honor policy. If you believe you may have committed an Honor Offense, you may wish to file a Conscientious Retraction by calling the Honor Offices at (434) 924-7602. For your retraction to be considered valid, it must, among other things, be filed with the Honor Committee before you are aware that the act in question has come under suspicion by anyone. More information can be found at <http://honor.virginia.edu>. Your Honor representatives can be found at: <http://honor.virginia.edu/representatives>.

Recording of Classroom Activities

The intent for this semester is to have all classes live and in-person. With that said, we may find the need to record specific lectures and other interactions as needed. Because these interactions may include fellow students, you and they may be personally identifiable on the recordings. These recordings may only be used for the purpose of individual or group study with other students enrolled in this class during this semester. You may not distribute them in whole or in part through any other platform or to any persons outside of this class, nor may you make your own recordings of this class unless written permission has been obtained from the instructor and all participants in the class have been informed that recording will occur. Please see Provost Policy 008 for additional details.

Artificial Intelligence Technologies

The ethical use of artificial intelligence technologies is strictly at the discretion of the course's professor and **is otherwise prohibited without the professor's explicit written or verbal permission.**

Students with Disabilities or Learning Needs

It is my goal to create a learning experience that is as accessible as possible. If you anticipate any issues related to the format, materials, or requirements of this course, please meet with me outside of class so we can explore potential options. Students with disabilities may also wish to work with the Student Disability Access Center to discuss a range of options to removing barriers in this course, including official accommodations. Please visit their website for information on this process and to apply for services online: sdac.studenthealth.virginia.edu. If you have already been approved for accommodations through SDAC, please send me your accommodation letter and meet with me so we can develop an implementation plan together.

Discrimination and Power-Based Violence

The University of Virginia is dedicated to providing a safe and equitable learning environment for all students. To that end, it is vital that you know two values that I and the University hold as critically important:

1. Power-based personal violence will not be tolerated.
2. Everyone has a responsibility to do their part to maintain a safe community on Grounds.

If you or someone you know has been affected by power-based personal violence, more information can be found on the UVA Sexual Violence website that describes reporting options and resources available - www.virginia.edu/sexualviolence.

As your professor and as a person, know that I care about you and your well-being and stand ready to provide support and resources as I can. As a faculty member, I am a responsible employee, which means that I am required by University policy and federal law to report what you tell me to the University's Title IX Coordinator. The Title IX Coordinator's job is to ensure that the reporting student receives the resources and support that they need, while also reviewing the information presented to determine whether further action is necessary to ensure survivor safety and the safety of the University community. If you wish to report something that you have seen, you can do so at the **Just Report It portal**. **The worst possible situation would be for you or your friend to remain silent when there are so many here willing and able to help.**

Religious Accommodations

It is the University's long-standing policy and practice to reasonably accommodate students so that they do not experience an adverse academic consequence when sincerely held religious beliefs or observances conflict with academic requirements. Students who wish to request academic accommodation for a religious observance should submit their request in writing directly to me. Students who have questions or concerns about academic accommodations for religious observance or religious beliefs may contact the University's Office for Equal Opportunity and Civil Rights (EOCR) at UVAEOCR@virginia.edu or 434-924-3200.