

Metallurgical Engineering B.S. and Minor (Materials Science – Metals)



Contact Information

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Faculty

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Materials and Metallurgical Engineering

Materials and metallurgical engineering is the branch of engineering that develops and supplies the materials for virtually every other engineering field. Three-fourths of all elements are metals, so metals play a vital role in nearly every aspect of modern life. Metallurgical engineers transform the Earth's mineral resources into finished products by extracting metals from ores, producing ceramics from metal compounds, and fabricating composite structures.

Modern materials are exotic and so are the methods of producing them. Metallurgy is based upon the principles of chemistry, physics, and

mathematics. These sciences provide an understanding of the methods of metal production processes and the behavior of materials. In addition to familiar materials such as steel, aluminum, copper, glass, gold, and silver, metallurgical engineers produce many exotic materials such as metals with shape memories, ultrahigh-purity materials for integrated circuits, materials for surgical implants, ceramics for space vehicles, nano-scale metal particles and superconductors. There are 3 areas of specialization in metallurgical engineering: mineral processing, extractive metallurgy, and materials engineering. Mineral processors concentrate ores and recycled materials so that extractive metallurgists can produce pure, high-quality metals and non-metals for use by materials engineers who transform these materials into the marvels of our advanced civilization, ranging from space craft to thin diamond films. Metallurgical engineers are actively involved in nanotechnology and the production and utilization of nano-scale materials.

Advances made by metallurgical and material engineers make advances possible in other engineering fields. This happens because virtually every engineering field is in constant search of higher-performing materials. Metallurgical engineers are responsible for the production of materials and also for the evaluation of metals, ceramics, and polymer-based composites. The evaluation of materials includes tests to determine strength, hardness, toughness, corrosion behavior, and many other properties. It is the role of metallurgical engineers to develop processing methods to create materials with specific and exacting properties for every conceivable application.

The primary source for materials continues to be extracted as ores and petroleum from the Earth. However, recycled materials are an increasingly important material source for metallurgical engineers.

Materials and metallurgical engineers are employed throughout the nation and the world.

The Objectives of the B.S. Metallurgical Engineering Degree Program

The program graduates will:

- Successfully apply metallurgical engineering principles in their employment
- Meet societal needs through science and technology
- Grow professionally and personally
- Serve their profession and community

Materials and Metallurgical Engineering Laboratories

Laboratory facilities in metallurgical engineering are equipped for instruction in mineral processing, chemical metallurgy, physical metallurgy, and mechanical metallurgy. Sample preparation facilities, laser light scattering particle size analyzers, gravitational separation equipment, laser Doppler particle size and zeta potential measurement equipment are available for mineral and materials processing. Induction melting and vacuum furnaces, fluidized-bed reactors, corrosion potentiostat, contact angle goniometer, and high pressure autoclaves are available for chemical metallurgy. X-ray diffraction spectrometer, Fourier transform infrared spectrometer, Raman spectrometer, Langmuir-Blodgett trough, metallographs, atomic force microscope, controlled atmosphere furnaces, quantitative image analyzer, scanning and transmission electron microscopes, universal testing machine (MTS), Charpy impact testing machine, and micro hardness, Rockwell and Vickers hardness testers are available for measuring material performance.

Modern laboratory facilities for welding and joining are available within the metallurgical engineering laboratories. These facilities include traditional joining (fusion welding) as well as advanced joining (friction stir joining) equipment.

Co-Curricular Opportunities

Co-curricular opportunities in blacksmithing and the artistic aspects of metallurgy are also available. Where appropriate, these co-curricular activities are integrated into the metallurgical engineering curriculum.

The program hosts the summer Research Experiences for Undergraduates (REU) Site: *Back*

to the Future! The REU Site is sponsored by the National Science Foundation.

Minor in Materials Science — Metals

The requirements for a minor in materials science — Metals are MET 232, 330, 332, 443, and two classes from MET 430, 440 and 445, for a total of 18 credits. MET 330, MET 332, MET 440, MET 443 and MET 445 are offered in alternate years, so plans for a materials science-metals minor should be made early. This minor is designed for students in engineering and science disciplines that desire focused training in the field of materials science with special emphasis on metals. Students completing the minor in materials science-metals will demonstrate the following outcomes:

1. A proficiency in materials science concepts covering metals and alloys;
2. The ability to develop and improve new metals/alloys;
3. The ability to predict and evaluate the performance of metals and alloys.

Given the redundancy in the B.S. metallurgical engineering core curriculum, the minor in materials science-metals is not available to those students who receive a B.S. degree in metallurgical engineering. A minor in materials science-metals must be approved by the student's major department. The Office of the Registrar and Academic Services has forms that should be completed and signed by the department heads from both departments involved in this minor.

Metallurgical Engineering Curriculum/Checklist

Students are responsible for checking with their advisors for any program modifications that may occur after the publication of this catalog.

<u>Freshman Year</u>		
First Semester		
MATH 123	Calculus I ⁵	4
CHEM 112	General Chemistry I ⁶	3

ENGL 101	Composition I ¹	3
GE 130	Intro to Engineering	2
PE	Physical Education	1
	Humanities or Social Sciences Elective(s) ^{3,4}	3
TOTAL		16

Second Semester

MATH 125	Calculus II	4
CHEM 114	General Chemistry II ⁶ OR	3
BIOL 151	General Biology I ⁶ OR	3
BIOL 153	General Biology II ⁶	3
PHYS 211	University Physics I	3
CHEM 112L	General Chem Lab	1
PE	Physical Education	1
	Humanities or Social Sciences Elective(s) ^{3,4}	3
	Humanities or Social Sciences Elective(s) ^{3,4}	3
TOTAL		18

Sophomore Year

First Semester

MET 232	Properties of Materials	3
MET 231	Structures and Properties of Materials Lab	1
MATH 321	Differential Equations	4
PHYS 213	University Physics II	3
CHEM 114L	General Chem II Lab OR	1
BIOL 151L	General Biology I Lab OR	1
BIOL 153L	General Biology II Lab	1
ENGL 279	Technical Comm ¹¹	3
EM 214	Statics	3
TOTAL		18

Second Semester

MATH 225	Calculus III	4
EM 321	Mechanics of Materials OR	3
ME 216	Intro to Solid Mechanics	3
PHYS 213L	University Physics II Lab	1
MET 220	Min Proc and Res Recov	3
MET 220L	Min Proc and Res Recov Lab	1
	Humanities or Social Sciences Elective(s) ^{3,4}	4
TOTAL		16

Junior Year

First Semester

ENGL 289	Technical Comm II ²	3
MET 320	Metallurg Thermodynamics	4
MET 351	Engineering Design I	2
	Set A or C	7
TOTAL		16

Second Semester

MET 352	Engineering Design II	1
MATH 373	Intro to Numerical Analysis	3
	Free Elective	2
	Set B or D	11
TOTAL		17

Senior Year

First Semester

MET 464	Engineering Design III	2
IENG 301	Basic Engineering Econ Science Elective ⁷	2 3
	Humanities or Social Sciences Elective(s)	3
	Set A or C	7
TOTAL		17

Second Semester

MET 433	Process Control	3
MET 465	Engineering Design IV	1
	Science Elective ⁷	3
	Set B or D	11
TOTAL		18

136 credits required for graduation

Curriculum Notes

- ¹ Satisfies General Education Goal #1
- ² Satisfies General Education Goal #2
- ³ Satisfies General Education Goal #3
- ⁴ Satisfies General Education Goal #4
- ⁵ Satisfies General Education Goal #5
- ⁶ Satisfies General Education Goal #6
- ⁷ See Advisor for approved Science Electives

Set A-Fall Even Years

MET 422	Transport Phenomena	4
	Free Elective	3

Set B-Spring Odd Years

MET 321	High Temp Extract/Conc/Rec	4
	Directed Met Elective	3
EE 301	Intro Circuits, Machines, Syst	4

Set C-Fall Odd Years

MET 330	Physics of Metals	3
MET 330L	Physics of Metals Lab	1
MET 332	Thermomechanical Treatment	3

Set D-Spring Even Years

MET 440	Mechanical Metallurgy	3
MET 440L	Mechanical Metallurgy Lab	1
Directed Met Elective		3
MET 310	Aqueous Extract/Conc/Rec	3
MET 310L	Aq Extract/Conc/Rec Lab	1

