PURDUE UNIVERSITY | College of Engineering

MATERIALS ENGINEERING ONLINE GRADUATE COURSES

CONSISTENLY RANKED AMONG THE TOP 5 IN BEST ONLINE ENGINEERING GRADUATE PROGRAMS BY U.S. NEWS & WORLD REPORT

The 30 credit hour online Materials Engineering Master's concentration falls within Purdue University's Interdisciplinary Engineering Master's degree. The concentration and full master's degree is designed for professionals who want to enhance their careers through developing cutting-edge knowledge in materials science and engineering and leading innovations in the five main classes of materials - metals, ceramics, polymers, composites, and biomaterials. As a student in this concentration, you will focus on materials topics and technical knowledge like additive manufacturing, machine learning, high-resolution microscopy, and materials fatigue.

BEST ONLINE PROGRAMS U.S.News & WORLD REPORT GRAD ENGINEERING 2021

Students within the Interdisciplnary Master's of Engineering degree will learn from the same renowned faculty who teach on campus at Purdue. Thesis and non-thesis options are also offered.

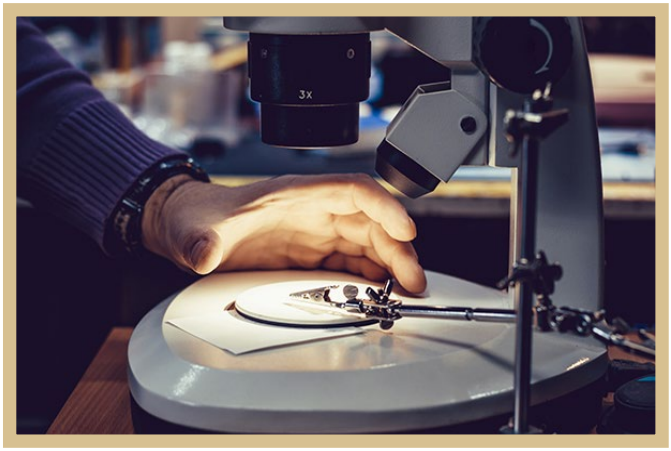
Below is an evolving list of online materials engineering courses. An updated list of online engineering courses can be found at https://engineering.purdue.edu/online/courses/schoollistings.

MICROSTRUCTURAL CHARACTERIZATION TECHNIQUES

Measurement and metrology is continually one of the most active areas in the study and verification of materials and their processing. Materials structure at the micro-and nano-scales must be carefully controlled and monitored in modern industry and research. Students will: learn what tool to use for materials analysis/characterization; become familiar with all major techniques for analysis of microstructural features, both structural and chemical; know which techniques are most useful for their particular situations; and understand the fundamental workings and limitations of the techniques and instruments.

Introduction to Biomaterials

This course is designed to provide foundational knowledge of biomaterial science principles. It presents a balanced perspective on the evolving discipline of Biomaterials Science by including information on hard and soft biomaterials, orthopedic ideas, cardiovascular concepts, ophthalmologic ideas, and dental issues. Subjects will include a balance of fundamental biological concepts, materials science, medical/clinical concerns, and coverage of biomaterials past, present, and future. The aim of the course is for students to gain a solid appreciation for the special significance of the word biomaterial as well as the rapid and exciting evolution and expansion of biomaterials science and its applications in medicine.



Courses continued....

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MECHANICAL PROPERTIES AND BEHAVIORS OF POLYMERS

This course will focus on the mechanical properties and behaviors of polymeric materials. The course will utilize fundamental solid and fluid mechanics to understand the response of bulk polymers (solid and liquid, above and below Tg). The impact of deformation rate and temperature on the mechanical response of polymers will be covered in detail. The course will start with an overview of linear elastic mechanics, move to rubber elasticity, and then viscoelasticity (concentrating on time-temperature superposition). We will also cover fluid dynamics and the rheology of non-Newtonian fluids. We will conclude with a section on deformation, yield, and fracture mechanisms (focusing on those phenomena that are unique to polymers such as rubber cavitation and crazing).

ADDITIVE MANUFACTURING OF MATERIALS

The course will take a materials science and engineering approach to additive manufacturing (AM). The overarching goal is to learn how microstructure development is controlled by the interaction of physical, chemical, thermal and mechanical phenomena in the shaping of materials by additive processing. All major classes of materials and AM processes will be included. Other objectives are to develop the ability to quantitatively analyze the capabilities and limitations of AM processes relative to current commercial processes; and critically analyze the AM research literature. The course will also provide opportunities for students to explore AM topic area(s) of their own interest.

FACULTY SPOTLIGHT

Dr. Nikhilesh Chawla is the Ransburg Professor of Material Engineering at Purdue University. His research focuses on Four-Dimensional (4D) materials science with a particular emphasis on the deformation behavior of advanced materials at bulk and small length scales. He has co-authored nearly 260 journal publications in these areas, including the chronology of events that led to materials disasters from the collapse of the Columbia Space Shuttle, the World Trade Center tragedy, and the sinking of the Titantic. Dr. Chawla says of Materials Engineering, "materials are ubiquitous in our world, from aircraft, sporting goods, automotive, semiconductors, and biomedical devices. Materials are extremely important in high-performance engineering applications. As we like to say here at Purdue – you can't make it without materials!".

STEEL AND ALUMINUM: PROCESSING STRUCTURE AND PROPERTIES

Students will study steel and aluminum processing to understand fundamentals such as the impact of impurities and phase transformations. The study of processing will provide an understanding of how the final properties are influenced by the sequence of processes from the extraction of metal from ore, through casting, hot deformation and heat treating. This understanding will enable the student to go beyond comparisons of standard handbook values and to recognize and understand how the fundamental metallurgical phenomena lead to different performance among the various steels and aluminum alloys. By examining the relationships among processes, microstructure, and properties, the course will provide the "know-how" for better design with steel, aluminum and competing materials.

BATTERIES

Energy storage devices are ubiquitous and essential in diverse technology areas ranging from transportation, to portable and implantable electronic devices, to micro-grid applications. The material properties and microstructure of their constituent materials determine to a large extent the device power/ energy density, its performance and reliability as well its failure mechanisms. The following topics will be covered in the course: fundamental operating principles of energy storage devices, structural and charge transport characterization of energy storage materials and devices, electrochemical batteries, fuel cells, hydrogen and thermal storage, Li-ion and beyond-Li batteries, flexible and wearable devices, and fast-charging batteries. Emerging trends in rechargeable energy storage devices such as all-solid-state batteries will also be discussed.

MATERIALS ENGINEERING FUNDAMENTALS

This course teaches fundamental relationships between the internal structure, properties, and processing in all classes of engineering materials. Students will receive comprehensive coverage spanning physical, chemical, thermal, mechanical, electrical, magnetic, and optical responses. The course is intended for materials researchers from all backgrounds, as well as engineers working in product design, development and manufacturing who seek a deeper understanding of the full spectrum of engineering materials.

LEAN MANUFACTURING

Lean Manufacturing is about creating value. The Lean process starts with creating value for the ultimate customer which requires providing the right product at the right time for the specified price. While all manufacturing attempts to do this, what makes Lean Manufacturing distinct is the relentless pursuit and elimination of waste. Students will learn the concepts and tools of Lean which include types of waste, visual management, value stream analysis, flow, Just in Time, pull, and Kaizen.

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