

MATERIALS SCIENCE AND NANOENGINEERING

Contact Information

Materials Science and NanoEngineering

<https://msne.rice.edu/>

E200E George R. Brown Hall

713-348-3698

Pulickel Ajayan

Department Chair

ajayan@rice.edu

Materials engineering is concerned with the processing, structure, properties, and performance of diverse materials which include metals and their alloys, semiconductors, ceramics, glass, polymers, composites, and nanomaterials. The materials engineer applies principles of math, physics and chemistry to design, produce, characterize, and utilize materials essential to modern society. Examples range in size and properties from the nanometer-thick atomic layers which form transistors on integrated circuit chips to the single-crystal superalloy blades used in turbine engines to the metallic alloys used in transcontinental pipelines and power lines. The Materials Science and NanoEngineering curriculum provides students with the requisite skills and educational background to contribute to the solution of many materials and nanoengineering problems, allow graduates to work in a fascinating field, and make it possible to become a leader in one of the most challenging areas of technology.

The department's graduate degree programs include a non-thesis professional master's degree as well as research degrees which include a thesis. These programs, in their comprehensive educational and research activities, collaborate with other departments at Rice and other institutions and industry in Houston, including those in the Texas Medical Center. Collaborations are also extended to universities in the United States, Europe, Asia, North and South America. International collaborations include joint research activities as well as faculty and student visitor exchanges.

Graduate studies in the department may lead to specialization in one of several areas, including Advanced Manufacturing, Biomaterials, Carbon Nanomaterial Composites, Computational Materials Science, Material Modeling and Theories, Electron Microscopy and in situ Methods, Electronic Materials, Energy Conversion and Storage, Low Dimensional Materials, Mechanical Properties and Nanomechanics, Metallurgy & Metals Processing, Nanotechnology, Optical Materials, Photonics and Nanoplasmonics, Surfaces and Interfaces, Coatings and Thin Films, and Ultralight-Weight Ultrahigh-Strength Multifunctional Materials. For details about these faculty research areas, please go to the MSNE website (<http://www.msne.rice.edu>).

A coordinated MBA/MMSNE degrees program is also offered in conjunction with the Jesse H. Jones Graduate School of Business.

Bachelor's Programs

- Bachelor of Arts (BA) Degree with a Major in Materials Science and NanoEngineering (ga.rice.edu/programs-study/departments-programs/engineering/materials-science-nanoengineering/materials-science-nanoengineering-ba)

ga.rice.edu/programs-study/departments-programs/engineering/materials-science-nanoengineering/materials-science-nanoengineering-ba)

- Bachelor of Science in Materials Science and NanoEngineering (BSMSNE) Degree (ga.rice.edu/programs-study/departments-programs/engineering/materials-science-nanoengineering/materials-science-nanoengineering-bsmsne)

Master's Programs

- Master of Materials Science and NanoEngineering (MMSNE) Degree (ga.rice.edu/programs-study/departments-programs-engineering/materials-science-nanoengineering/materials-science-nanoengineering-mmsne)
- Master of Science (MS) Degree in the field of Materials Science and NanoEngineering (ga.rice.edu/programs-study/departments-programs/engineering/materials-science-nanoengineering/materials-science-nanoengineering-ms)

Doctoral Program

- Doctor of Philosophy (PhD) Degree in the field of Materials Science and NanoEngineering (ga.rice.edu/programs-study/departments-programs/engineering/materials-science-nanoengineering/materials-science-nanoengineering-phd)

Coordinated Programs

- Master of Materials Science and NanoEngineering (MMSNE) Degree / Master of Business Administration (MBA) Degree (ga.rice.edu/programs-study/departments-programs/engineering/materials-science-nanoengineering/business-administration-mba-materials-science-nanoengineering-mmsne)

Chair

Pulickel M. Ajayan

Associate Chair

Jun Lou

Professors

Enrique V. Barrera

Edwin L. Thomas

Boris I. Yakobson

Assistant Professors

Zachary Cordero

Eilaf Egap

Ming Tang

Hanyu Zhu

Professor Emeritus

Rex B. McLellan

Research Professor

Robert Vajati

Associate Research Professors

Wade Adams

Alberto Pimpinelli

Assistant Research Professors

Evgeni Penev
Hua Guo

Professor in the Practice

Peter Loos

Lecturer

Randy John

Joint Appointments

Pedro J.J. Alvarez
Gang Bao
Andrew R. Barron
Yildiz Bayazitoglu
Sibani Lisa Biswal
Naomi J. Halas
Junichiro Kono
Qilin Li
Antonios G. Mikos
Satish Nagarajaiah
Douglas Natelson
Peter Nordlander
Matteo Pasquali
Gustavo E. Scuseria
Pol D. Spanos
James M. Tour
Rafael Verduzco
R. Bruce Weisman
Peter G. Wolynes
Michael S. Wong

Adjunct Professors

Sivaram Arepalli
Lijie Ci
Feng Ding
Sergio D. Kapusta
Valery N. Khabashesku
Ajit Roy
Glaura Goulart Silva
Abhishek Kumar Singh
Venkataraman Swaminathan

For Rice University degree-granting programs:

To view the list of official course offerings, please see Rice's Course Catalog (https://courses.rice.edu/admweb!/SWKSCAT.cat?p_action=cata)

To view the most recent semester's course schedule, please see Rice's Course Schedule (<https://courses.rice.edu/admweb!/SWKSCAT.cat>)

Materials Science & NanoEng (MSNE)

MSNE 201 - INTRODUCTION TO NANOENGINEERING

Short Title: INTRO TO NANOENGINEERING

Department: Materials Science & NanoEng

Grade Mode: Standard Letter

Course Type: Lecture

Distribution Group: Distribution Group III

Credit Hours: 3

Restrictions: Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.

Course Level: Undergraduate Lower-Level

Description: Introduction to the properties of nanomaterials and their applications in engineering, technology, chemistry, energy, biology, and medicine. General discussion of nanotechnology, from multidisciplinary research to consumer products, suitable for all levels and specializations. Students will develop the understanding needed to separate the hype from the real in one of the most dynamic and prolific areas of research in the last ten years. Includes demonstrations, student-lead projects, and lab tours. Required for MSNE majors.

MSNE 210 - WILD TOPICS IN CHEMISTRY AND NANOTECHNOLOGY

Short Title: WILD TOPICS CHEM AND NANOTECH

Department: Materials Science & NanoEng

Grade Mode: Standard Letter

Course Type: Lecture

Credit Hour: 1

Restrictions: Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.

Course Level: Undergraduate Lower-Level

Description: A variety of topics related to chemistry and nanotechnology will be discussed. Some topics are classical while others are current. Topics may include nanocars, molecular electronics, how to form a start-up company. Grades will be based upon attendance and quizzes. Cross-list: CEVE 210, CHEM 210. Repeatable for Credit.

MSNE 238 - SPECIAL TOPICS

Short Title: SPECIAL TOPICS

Department: Materials Science & NanoEng

Grade Mode: Standard Letter

Course Type: Internship/Practicum, Lecture, Seminar, Laboratory

Credit Hours: 1-4

Restrictions: Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.

Course Level: Undergraduate Lower-Level

Description: Topics and credit hours may vary each semester. Contact department for current semester's topic(s). Repeatable for Credit.

MSNE 301 - MATERIALS SCIENCE

Short Title: MATERIALS SCIENCE

Department: Materials Science & NanoEng

Grade Mode: Standard Letter

Course Type: Lecture

Distribution Group: Distribution Group III

Credit Hours: 3

Restrictions: Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.

Course Level: Undergraduate Upper-Level

Description: Introduction to the science of solid materials. Includes metals, ceramics, plastics, and semiconductors, as well as the properties of solid materials from atomic and macroscopic points of view. Required for materials science and engineering majors.

MSNE 302 - MATERIALS PROCESSING AND NANOMANUFACTURING**Short Title:** MATERIALS PROCESSING**Department:** Materials Science & NanoEng**Grade Mode:** Standard Letter**Course Type:** Lecture**Credit Hours:** 3**Restrictions:** Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.**Course Level:** Undergraduate Upper-Level**Prerequisite(s):** MATH 211 and MATH 212**Corequisite:** MSNE 303**Description:** An overview of mass, momentum, and heat transport with applications in materials processing and nanomanufacturing. Emphasis is on analytical modeling of processing techniques with a view towards improving their efficiency and yield.**MSNE 303 - MATERIALS SCIENCE JUNIOR LAB****Short Title:** MATERIALS SCIENCE JUNIOR LAB**Department:** Materials Science & NanoEng**Grade Mode:** Standard Letter**Course Type:** Laboratory**Credit Hour:** 1**Restrictions:** Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.**Course Level:** Undergraduate Upper-Level**Corequisite:** MSNE 302**Description:** Selected lab experiments in materials science. Open only to junior materials science and engineering majors. Required for materials science and engineering majors. At the start of the semester, please check with the Department of Mechanical Engineering and Materials Science for the time and location of the organizational meeting for the course. Instructor Permission Required.**MSNE 311 - MATERIALS SELECTION AND DESIGN****Short Title:** MATERIALS SELECTION & DESIGN**Department:** Materials Science & NanoEng**Grade Mode:** Standard Letter**Course Type:** Lecture**Credit Hours:** 4**Restrictions:** Enrollment is limited to students with a major in Materials Science & NanoEng. Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.**Course Level:** Undergraduate Upper-Level**Prerequisite(s):** MSNE 301**Description:** Polymers, metals, ceramics, glass, and composite materials are considered for various applications such as containers, refractories, medical devices, electronics, machine components, etc. based on their many diverse and useful material properties. For non-majors with permission of instructor. Required for Materials Science and NanoEngineering.**MSNE 365 - NANOMATERIALS FOR ENERGY****Short Title:** NANOMATERIALS FOR ENERGY**Department:** Materials Science & NanoEng**Grade Mode:** Standard Letter**Course Type:** Lecture/Laboratory**Credit Hours:** 3**Restrictions:** Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.**Course Level:** Undergraduate Upper-Level**Description:** This course will introduce students to the fundamental science of nanomaterials. Many of the concepts will be explained by drawing from applications in sustainability (photovoltaics, solar-to-fuel conversion thermionic, thermoelectric, fuel cells). Students will design a lab demo from scratch using amongst others the infrastructure provided by the photonics measurement lab. Cross-list: ELEC 365.**MSNE 401 - THERMODYNAMICS IN MATERIALS SCIENCE****Short Title:** THERMODYNAMICS IN MAT SCIENCE**Department:** Materials Science & NanoEng**Grade Mode:** Standard Letter**Course Type:** Lecture**Credit Hours:** 3**Restrictions:** Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.**Course Level:** Undergraduate Upper-Level**Prerequisite(s):** CHEM 122 and MATH 212**Description:** Unified presentation of the kinetics and thermodynamics of mass and energy transport. Includes heterogeneous equilibrium, diffusion in solids, and heat transfer, as well as their application to engineering design. Required for materials science and engineering majors. Graduate/Undergraduate Equivalency: MSNE 503. Mutually Exclusive: Credit cannot be earned for MSNE 401 and MSNE 503.**MSNE 402 - MECH PROPERTIES OF MATERIALS****Short Title:** MECH PROPERTIES OF MATERIALS**Department:** Materials Science & NanoEng**Grade Mode:** Standard Letter**Course Type:** Lecture**Credit Hours:** 3**Restrictions:** Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.**Course Level:** Undergraduate Upper-Level**Prerequisite(s):** MATH 211 and MSNE 301**Description:** Survey of the mechanical properties of solid materials. Includes basic mechanics, elasticity, plasticity, fracture, fatigue, creep, hardening mechanisms, mechanical testing, and structure-property relationships. Required for materials science and engineering majors. Graduate/Undergraduate Equivalency: MSNE 502. Mutually Exclusive: Credit cannot be earned for MSNE 402 and MSNE 502.

MSNE 406 - PHYSICAL PROPERTIES OF SOLIDS**Short Title:** PHYSICAL PROPERTIES OF SOLIDS**Department:** Materials Science & NanoEng**Grade Mode:** Standard Letter**Course Type:** Lecture**Credit Hours:** 3**Restrictions:** Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.**Course Level:** Undergraduate Upper-Level**Prerequisite(s):** MATH 211**Description:** Survey of the electrical, magnetic, and optical properties of metals, semiconductors, and dielectrics based upon elementary band theory concepts. Required for materials science and engineering majors. Graduate/Undergraduate Equivalency: MSNE 506. Mutually Exclusive: Credit cannot be earned for MSNE 406 and MSNE 506.**MSNE 407 - CAPSTONE DESIGN PROJECT I****Short Title:** CAPSTONE DESIGN PROJECT I**Department:** Materials Science & NanoEng**Grade Mode:** Standard Letter**Course Type:** Laboratory**Credit Hours:** 4**Restrictions:** Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.**Course Level:** Undergraduate Upper-Level**Prerequisite(s):** MSNE 303 and MSNE 311**Description:** An interdisciplinary capstone design experience in materials science and nanoengineering. This course provides an opportunity for students to apply knowledge and skills acquired in previous courses to the solution of a realistic engineering problem. Teams of students will specify, design, and build an engineering system/device to meet a prescribed set of requirements. Must complete MSNE 408 to receive credit for MSNE 407 and both courses must be taken the same academic year. Required for MSNE majors in B.S. program. Instructor Permission Required.**MSNE 408 - CAPSTONE DESIGN PROJECT II****Short Title:** CAPSTONE DESIGN PROJECT II**Department:** Materials Science & NanoEng**Grade Mode:** Standard Letter**Course Type:** Laboratory**Credit Hours:** 3**Restrictions:** Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.**Course Level:** Undergraduate Upper-Level**Description:** An interdisciplinary capstone design experience in materials science and nanoengineering. This course provides an opportunity for students to apply knowledge and skills acquired in previous courses to the solution of a realistic engineering problem. Teams of students will specify, design, and build an engineering system/device to meet a prescribed set of requirements. Must complete MSNE 407 to receive credit for MSNE 408 and both courses must be taken the same academic year. Required for MSNE majors in B.S. program. Instructor Permission Required.**MSNE 409 - PHYSICAL METALLURGY****Short Title:** PHYSICAL METALLURGY**Department:** Materials Science & NanoEng**Grade Mode:** Standard Letter**Course Type:** Lecture**Credit Hours:** 3**Restrictions:** Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.**Course Level:** Undergraduate Upper-Level**Description:** Fundamentals of metallic materials, with a focus on defect engineering, microstructure design, and alloy design. The course will provide students with the understanding needed to develop alloys with specific desirable properties. Examples will be drawn from the processing of both ferrous and non-ferrous (e.g., Cu-, Al-, and Ti based) alloys. Graduate/Undergraduate Equivalency: MSNE 509. Recommended Prerequisite(s): MSNE 435 and MSNE 411. Mutually Exclusive: Credit cannot be earned for MSNE 409 and MSNE 509.**MSNE 411 - METALLOGRAPHY AND PHASE RELATIONS****Short Title:** METALLOGRAPHY & PHASE RELATION**Department:** Materials Science & NanoEng**Grade Mode:** Standard Letter**Course Type:** Lecture**Credit Hours:** 3**Restrictions:** Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.**Course Level:** Undergraduate Upper-Level**Prerequisite(s):** MSCI 301 or MSNE 301**Description:** Study of microstructures that may be observed in metals and alloys, optical metallography (in addition to more sophisticated techniques), and the relationships between structural properties and failures. Required for materials science and engineering majors.**MSNE 415 - CERAMICS AND GLASSES****Short Title:** CERAMICS AND GLASSES**Department:** Materials Science & NanoEng**Grade Mode:** Standard Letter**Course Type:** Lecture**Credit Hours:** 3**Restrictions:** Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.**Course Level:** Undergraduate Upper-Level**Prerequisite(s):** MSNE 301 or MSCI 301**Description:** Fundamentals of ceramic and glassy materials, including phase relations, theoretical properties, structure, bonding, and design.

MSNE 416 - STRUCTURE AND PROPERTIES OF POLYMERS AND SOFT MATERIALS**Short Title:** PROPERTIES OF SOFT MATERIALS**Department:** Materials Science & NanoEng**Grade Mode:** Standard Letter**Course Type:** Lecture**Credit Hours:** 3**Restrictions:** Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.**Course Level:** Undergraduate Upper-Level**Prerequisite(s):** MSNE 301 and MSNE 302 (may be taken concurrently) and MSNE 401 (may be taken concurrently) and MSNE 402 (may be taken concurrently) and MSNE 406 (may be taken concurrently)**Description:** This course addresses the fundamental structures and properties of polymers and other forms of soft matter (gels, colloids, nanoparticles, etc.) and their many roles as technologically important materials. The electrical, optical, transport, acoustic and mechanical properties are presented with respect to the underlying physics and engineering. Prereqs are concurrent except for MSNE 301. Cross-list: CHBE 416. Graduate/Undergraduate Equivalency: MSNE 516. Mutually Exclusive: Credit cannot be earned for MSNE 416 and MSNE 516.**MSNE 417 - ELECTRONIC, OPTICAL AND MAGNETIC PROPERTIES OF POLYMERS****Short Title:** POLYMER ELECTRONICS**Department:** Materials Science & NanoEng**Grade Mode:** Standard Letter**Course Type:** Lecture**Credit Hours:** 3**Restrictions:** Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.**Course Level:** Undergraduate Upper-Level**Prerequisite(s):** CHEM 211 or MSNE 301**Description:** Covers physical and material concepts and engineering applications of electronic polymers. Examines the structural origins of the diverse electronic, optoelectronic, photonic and magnetic properties of conjugated polymers. Topics include synthesis, electronic structure, physico-chemical characterization, applications in LEDs, solar cells, transistors, spintronics, and bioelectronics. Graduate/Undergraduate Equivalency: MSNE 517. Mutually Exclusive: Credit cannot be earned for MSNE 417 and MSNE 517.**MSNE 433 - COMPUTATIONAL MATERIALS MODELING****Short Title:** COMPUTATIONAL MATERIALS MODEL**Department:** Materials Science & NanoEng**Grade Mode:** Standard Letter**Course Type:** Lecture**Credit Hours:** 3**Restrictions:** Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.**Course Level:** Undergraduate Upper-Level**Description:** Physico-chemical principles augmented by ever-advancing computation technology have become a tool for explaining rich materials properties, designing nano-structures and their possible functionality. This course overviews basic quantum principles of materials structure, and a hierarchy of approximations broadly used in computational models. This includes classical multi-body potentials, tight-binding approximations, electronic density functional theory methods, etc. Graduate/Undergraduate Equivalency: MSNE 533. Mutually Exclusive: Credit cannot be earned for MSNE 433 and MSNE 533.**MSNE 435 - CRYSTALLOGRAPHY & DIFFRACTION****Short Title:** CRYSTALLOGRAPHY & DIFFRACTION**Department:** Materials Science & NanoEng**Grade Mode:** Standard Letter**Course Type:** Lecture**Credit Hours:** 3**Restrictions:** Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.**Course Level:** Undergraduate Upper-Level**Prerequisite(s):** MSNE 301 or MSCI 301**Description:** Study of crystals by diffraction techniques, focusing on x-ray, with an overview of electron and neutron diffraction as well as complementary techniques. Provides mathematical foundations and nomenclature for diffraction and related phenomena. Includes basics of crystallographic analysis and surface/point/space group symmetry, experiment design (sources, geometry, detectors), and data analysis and interpretation. Required for undergraduate MSNE major. Meets with MSNE 535 (less course work for the undergraduate class). Graduate/Undergraduate Equivalency: MSNE 535. Mutually Exclusive: Credit cannot be earned for MSNE 435 and MSNE 535.**MSNE 437 - CRYSTALLOGRAPHY & DIFFRAC LAB****Short Title:** CRYSTALLOGRAPHY & DIFFRAC LAB**Department:** Materials Science & NanoEng**Grade Mode:** Standard Letter**Course Type:** Laboratory**Credit Hour:** 1**Restrictions:** Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.**Course Level:** Undergraduate Upper-Level**Prerequisite(s):** MSNE 435 (may be taken concurrently)**Description:** Selected laboratory experiments in materials science, focusing on lattice symmetry, crystallography, phase identification, and metallurgy. Required for undergraduate MSNE major. Prerequisite MSNE 435 may be taken concurrently. Instructor Permission Required. Graduate/Undergraduate Equivalency: MSNE 537. Mutually Exclusive: Credit cannot be earned for MSNE 437 and MSNE 537.**MSNE 450 - MATERIALS SCIENCE SEMINAR****Short Title:** MATERIALS SCIENCE SEMINAR**Department:** Materials Science & NanoEng**Grade Mode:** Satisfactory/Unsatisfactory**Course Type:** Seminar**Credit Hours:** 0**Restrictions:** Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.**Course Level:** Undergraduate Upper-Level**Description:** A series of seminars on selected topics in Materials Science. Recommended for Materials Science and NanoEngineering majors.**MSNE 451 - MATERIALS SCIENCE SEMINAR****Short Title:** MATERIALS SCIENCE SEMINAR**Department:** Materials Science & NanoEng**Grade Mode:** Satisfactory/Unsatisfactory**Course Type:** Seminar**Credit Hour:** 1**Restrictions:** Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.**Course Level:** Undergraduate Upper-Level**Description:** A series of seminars on selected topics in Materials Science. Recommended for Materials Science and NanoEngineering majors.

MSNE 477 - SPECIAL TOPICS**Short Title:** SPECIAL TOPICS**Department:** Materials Science & NanoEng**Grade Mode:** Standard Letter**Course Type:** Seminar, Lecture, Laboratory, Internship/Practicum**Credit Hours:** 1-4**Restrictions:** Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.**Course Level:** Undergraduate Upper-Level**Description:** Topics and credit hours may vary each semester. Contact department for current semester's topic(s). Repeatable for Credit.**MSNE 490 - MATERIALS SCIENCE RESEARCH PROJECTS****Short Title:** MATERIAL SCIENCE RESEARCH PROJ**Department:** Materials Science & NanoEng**Grade Mode:** Standard Letter**Course Type:** Research**Credit Hours:** 1-3**Restrictions:** Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.**Course Level:** Undergraduate Upper-Level**Description:** Independent investigation of a specific topic or problem in materials science. Research under the direction of a selected faculty member. Instructor Permission Required. Repeatable for Credit.**MSNE 491 - SUPERVISED RESEARCH****Short Title:** SUPERVISED RESEARCH**Department:** Materials Science & NanoEng**Grade Mode:** Standard Letter**Course Type:** Research**Credit Hours:** 1-3**Restrictions:** Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.**Course Level:** Undergraduate Upper-Level**Prerequisite(s):** MATH 101 and MATH 102**Description:** Supervised research, reports and/or final reports required. Sponsorship by faculty member required. Instructor Permission Required. Repeatable for Credit.**MSNE 499 - CURRENT TOPICS****Short Title:** CURRENT TOPICS**Department:** Materials Science & NanoEng**Grade Mode:** Standard Letter**Course Type:** Seminar**Credit Hours:** 1-9**Restrictions:** Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.**Course Level:** Undergraduate Upper-Level**Description:** Designed for undergraduate materials science students. Topics vary from term to term. Please consult with the department for additional information.**MSNE 500 - MATERIALS SCIENCE SEMINAR****Short Title:** MATERIALS SCIENCE SEMINAR**Department:** Materials Science & NanoEng**Grade Mode:** Satisfactory/Unsatisfactory**Course Type:** Seminar**Credit Hour:** 1**Restrictions:** Enrollment is limited to Graduate level students.**Course Level:** Graduate**Description:** A series of seminars on selected topics in Materials Science. Required for Materials Science and Engineering majors. Repeatable for Credit.**MSNE 501 - GRADUATE STUDENT SEMINAR****Short Title:** GRADUATE STUDENT SEMINAR**Department:** Materials Science & NanoEng**Grade Mode:** Satisfactory/Unsatisfactory**Course Type:** Seminar**Credit Hour:** 1**Restrictions:** Enrollment is limited to Graduate level students.**Course Level:** Graduate**Description:** Two graduate students will present every week, except for 1st year graduate students who will present 3 per class. Every week, students will be encouraged to fill out peer evaluation forms and include anonymous comments/suggestions for improving the presentation. The results of these comments will not be shared, but given to the presenter for their reference. Repeatable for Credit.**MSNE 502 - MECH PROPERTIES OF MATERIALS****Short Title:** MECH PROPERTIES OF MATERIALS**Department:** Materials Science & NanoEng**Grade Mode:** Standard Letter**Course Type:** Lecture**Credit Hours:** 3**Restrictions:** Enrollment is limited to Graduate level students.**Course Level:** Graduate**Description:** Survey of the mechanical properties of solid materials. Includes basic mechanics, elasticity, plasticity, fracture, fatigue, creep, hardening mechanisms, mechanical testing, and structure-property relationships. Required for Materials Science and Engineering majors. Additional work required. Graduate/Undergraduate Equivalency: MSNE 402. Mutually Exclusive: Credit cannot be earned for MSNE 502 and MSNE 402.**MSNE 503 - THERMODYNAMICS IN MATERIALS SCIENCE****Short Title:** THERMODYNAMICS IN MAT SCIENCE**Department:** Materials Science & NanoEng**Grade Mode:** Standard Letter**Course Type:** Lecture**Credit Hours:** 3**Restrictions:** Enrollment is limited to Graduate level students.**Course Level:** Graduate**Description:** Unified presentation of the kinetics and thermodynamics of mass and energy transport. Includes heterogeneous equilibrium, diffusion in solids, and heat transfer, as well as their application to engineering design. Required for Materials Science and Engineering majors. Graduate/Undergraduate Equivalency: MSNE 401. Mutually Exclusive: Credit cannot be earned for MSNE 503 and MSNE 401.**MSNE 505 - MICROSTRUCTURE AND NANOSTRUCTURE EVOLUTION****Short Title:** MICRO/NANO-STRUCTURE EVOLUTION**Department:** Materials Science & NanoEng**Grade Mode:** Standard Letter**Course Type:** Lecture**Credit Hours:** 3**Restrictions:** Enrollment is limited to Graduate level students.**Course Level:** Graduate**Description:** Study of the thermodynamic and kinetic principles underlying structural evolution in materials at micro- and nanoscales. Includes atomic diffusion, phase transformations and morphological evolution of surfaces and interfaces under capillary and mechanical forces. Elucidation of atomistic mechanisms and mathematical treatment are emphasized. Undergraduates may register with instructor permission. Recommended Prerequisite(s): MSNE 503.

MSNE 506 - PHYSICAL PROPERTIES OF SOLIDS**Short Title:** PHYSICAL PROPERTIES OF SOLIDS**Department:** Materials Science & NanoEng**Grade Mode:** Standard Letter**Course Type:** Lecture**Credit Hours:** 3**Restrictions:** Enrollment is limited to Graduate level students.**Course Level:** Graduate**Description:** Survey of the electrical, magnetic, and optical properties of metals, semiconductors, and dielectrics based upon elementary band theory concepts. Required for Materials Science and Engineering majors. Graduate/Undergraduate Equivalency: MSNE 406. Mutually Exclusive: Credit cannot be earned for MSNE 506 and MSNE 406.**MSNE 509 - PHYSICAL METALLURGY****Short Title:** PHYSICAL METALLURGY**Department:** Materials Science & NanoEng**Grade Mode:** Standard Letter**Course Type:** Lecture**Credit Hours:** 3**Restrictions:** Enrollment is limited to Graduate level students.**Course Level:** Graduate**Description:** Fundamentals of metallic materials, with a focus on defect engineering, microstructure design, and alloy design. The course will provide students with the understanding needed to develop alloys with specific desirable properties. Examples will be drawn from the processing of both ferrous and non-ferrous (e.g., Cu-, Al-, and Ti based) alloys. Graduate/Undergraduate Equivalency: MSNE 409. Recommended Prerequisite(s): MSNE 435 and MSNE 411. Mutually Exclusive: Credit cannot be earned for MSNE 509 and MSNE 409.**MSNE 510 - SCALING CONCEPTS IN 2D MATERIALS AND POLYMER PHYSICS****Short Title:** SCALING CONCEPTS IN MATERIALS**Department:** Materials Science & NanoEng**Grade Mode:** Standard Letter**Course Type:** Lecture**Credit Hours:** 3**Restrictions:** Enrollment is limited to Graduate level students.**Course Level:** Graduate**Description:** The course is an introduction to symmetry breaking, scaling and universality in low dimensional materials and polymers. Using simple models as examples, the course addresses 2D crystals and melting, surface roughening, scaling properties of polymers, phase transitions and the mean field approach. It then goes over to explain how renormalization works in condensed matter, and how it gives rise to universality. Recommended Prerequisite(s): MSNE 401**MSNE 516 - STRUCTURE AND PROPERTIES OF POLYMERS AND SOFT MATERIALS****Short Title:** PROPERTIES OF SOFT MATERIALS**Department:** Materials Science & NanoEng**Grade Mode:** Standard Letter**Course Type:** Lecture**Credit Hours:** 3**Restrictions:** Enrollment is limited to Graduate level students.**Course Level:** Graduate**Description:** This graduate level course addresses the fundamental structures and properties of polymers and other forms of soft matter (gels, colloids, nanoparticles, etc.) and their many roles as technologically important materials. The electrical, optical, transport, acoustic and mechanical properties are presented with respect to the underlying physics and engineering. Cross-list: CHBE 516. Graduate/Undergraduate Equivalency: MSNE 416. Mutually Exclusive: Credit cannot be earned for MSNE 516 and MSNE 416.**MSNE 517 - ELECTRONIC, OPTICAL AND MAGNETIC PROPERTIES OF POLYMERS****Short Title:** POLYMER ELECTRONICS**Department:** Materials Science & NanoEng**Grade Mode:** Standard Letter**Course Type:** Lecture**Credit Hours:** 3**Restrictions:** Enrollment is limited to Graduate level students.**Course Level:** Graduate**Description:** Covers physical and material concepts and engineering applications of electronic polymers. Examines the structural origins of the diverse electronic, optoelectronic, photonic and magnetic properties of conjugated polymers. Topics include synthesis, electronic structure, physico-chemical characterization, applications in LEDs, solar cells, transistors, spintronics, and bioelectronics. Graduate/Undergraduate Equivalency: MSNE 417. Mutually Exclusive: Credit cannot be earned for MSNE 517 and MSNE 417.**MSNE 523 - PROPERTIES, SYNTHESIS AND DESIGN OF COMPOSITE MATERIALS****Short Title:** DESIGN OF COMPOSITE MATERIALS**Department:** Materials Science & NanoEng**Grade Mode:** Standard Letter**Course Type:** Lecture**Credit Hours:** 3**Restrictions:** Enrollment is limited to Graduate level students.**Course Level:** Graduate**Description:** Study of the science of interfaces and the properties that govern their use in composite materials. Not offered every year. The study of composite processing and methods for synthesis polymer, metal and ceramic matrix composition.

MSNE 533 - COMPUTATIONAL MATERIALS MODELING**Short Title:** COMPUTATIONAL MATERIALS MODEL**Department:** Materials Science & NanoEng**Grade Mode:** Standard Letter**Course Type:** Lecture**Credit Hours:** 3**Restrictions:** Enrollment is limited to Graduate level students.**Course Level:** Graduate

Description: Physico-chemical principles augmented by ever-advancing computation technology have become a tool for explaining rich materials properties, designing nano-structures and their possible functionality. This course overviews basic quantum principles of materials structure, and a hierarchy of approximations broadly used in computational models. This includes classical multi-body potentials, tight-binding approximations, electronic density functional theory methods, etc. MSNE 533 requires additional work. Graduate/Undergraduate Equivalency: MSNE 433. Mutually Exclusive: Credit cannot be earned for MSNE 533 and MSNE 433.

MSNE 534 - NANOSCIENCE AND NANOTECHNOLOGY I**Short Title:** NANOSCIENCE & NANOTECHNOLOGY**Department:** Materials Science & NanoEng**Grade Mode:** Standard Letter**Course Type:** Lecture**Credit Hours:** 3**Restrictions:** Enrollment is limited to Graduate level students.**Course Level:** Graduate

Description: Enrollment is open to all students. Undergraduate enrollment requires instructor permission via special registration form. An introduction to the basic principles of nanoscience and nanotechnology. Size dependent physical properties of nanoscopic solids will be described using solid state physics and molecular orbital theory as a foundation. Wet chemical techniques that produce nanoscale materials (e.g. carbon nanotubes, semiconductor and metallic nanocrystals, dendrimers...) will be introduced in the second half of the semester. Expected to be taught Spring 2019. Cross-list: CEVE 533, CHEM 533.

MSNE 535 - CRYSTALLOGRAPHY & DIFFRACTION**Short Title:** CRYSTALLOGRAPHY & DIFFRACTION**Department:** Materials Science & NanoEng**Grade Mode:** Standard Letter**Course Type:** Lecture**Credit Hours:** 3**Restrictions:** Enrollment is limited to Graduate level students.**Course Level:** Graduate

Description: Study of crystals by diffraction techniques, focusing on x-ray, with an overview of electron and neutron diffraction as well as complementary techniques. Provides mathematical foundations and nomenclature for diffraction and related phenomena. Includes basics of crystallographic analysis and surface/point/space group symmetry, experiment design (sources, geometry, detectors), and data analysis and interpretation. Required for undergraduate MSNE major. Meets with MSNE 435 (additional work for the graduate version). Cross-list: PHYS 535. Graduate/Undergraduate Equivalency: MSNE 435. Mutually Exclusive: Credit cannot be earned for MSNE 535 and MSNE 435.

MSNE 537 - CRYSTALLOGRAPHY & DIFFRAC LAB**Short Title:** CRYSTALLOGRAPHY & DIFFRAC LAB**Department:** Materials Science & NanoEng**Grade Mode:** Standard Letter**Course Type:** Laboratory**Credit Hour:** 1**Restrictions:** Enrollment is limited to Graduate level students.**Course Level:** Graduate

Description: Selected laboratory experiments in materials science, focusing on lattice symmetry, crystallography, phase identification, and metallurgy. Required for undergraduate MSNE major. Credit may be given for only one, MSNE 537 or MSNE 437. Instructor Permission Required. Graduate/Undergraduate Equivalency: MSNE 437. Mutually Exclusive: Credit cannot be earned for MSNE 537 and MSNE 437.

MSNE 538 - COMPUTATIONAL NANOSCIENCE FOR GREEN INFRASTRUCTURE**Short Title:** COMPUTATIONAL NANOSCIENCE**Department:** Materials Science & NanoEng**Grade Mode:** Standard Letter**Course Type:** Seminar**Credit Hours:** 3**Restrictions:** Enrollment is limited to Graduate level students.**Course Level:** Graduate

Description: Computational methods such as first principles, kinetic Monte Carlo (KMC), classical MC (in Canonical, Grand Canonical, and isobaric-isothermal ensembles), and classic MD in predicting materials formation and properties. Case studies include cementitious materials, metals, and thermoelectric materials. Other case studies are possible depending on the student's background and instructor's approval. Cross-list: CEVE 538.

MSNE 545 - THIN FILMS**Short Title:** THIN FILMS**Department:** Materials Science & NanoEng**Grade Mode:** Standard Letter**Course Type:** Lecture**Credit Hours:** 3**Restrictions:** Enrollment is limited to Graduate level students.**Course Level:** Graduate

Description: Deposition methods, structure, properties, performance and failure mechanisms of thin solid films for various applications. Deposition methods include sputtering, plating, evaporation and chemical vapor deposition. Material types include crystalline and amorphous metals as well as semiconductors and insulators. Applications are primarily in microelectronics; data storage; micro-electro-mechanical systems, wear and corrosion prevention and thermal barriers. NOTE: Not offered every year. Cross-list: ELEC 545.

MSNE 555 - MATERIALS IN NATURE AND BIO-MIMETIC STRATEGIES**Short Title:** BIO-MIMETIC STRATEGIES**Department:** Materials Science & NanoEng**Grade Mode:** Standard Letter**Course Type:** Lecture**Credit Hours:** 3**Restrictions:** Enrollment is limited to Graduate level students.**Course Level:** Graduate

Description: This graduate level course will discuss the origin of several materials that exists in nature from a technology perspective and strategies to replicate them using synthetic materials processing protocols. Silicates, carbon based materials, abalone shell, bone etc. will be used to discuss the fascinating architecture developed by nature. Similarly several functional structures designed by nature such as Gecko tape and IR sensors will be discussed for designing bio-medical structure and devices. NOTE: Not offered every year.

MSNE 560 - COLLOIDAL AND INTERFACIAL PHENOMENA**Short Title:** COLLOIDAL & INTERFACIAL PHENOM**Department:** Materials Science & NanoEng**Grade Mode:** Standard Letter**Course Type:** Lecture**Credit Hours:** 3**Restrictions:** Enrollment is limited to Graduate level students.**Course Level:** Graduate

Description: The course will provide knowledge into the fundamentals of colloidal interactions (e.g., stabilisation, adsorption, self-assembly) and the techniques currently applied for their assessment. Apart from the theoretical background, the course will also provide applicable knowledge by covering current and emerging applications involving these phenomena. Interfacial tension, wetting and spreading, contact angle hysteresis, interaction between colloid particles, stability of interfaces, flow and transport near interfaces will be covered. NOTE: Offered in alternative year with MSNE 594/CHBE 594. Cross-list: CHBE 560.

MSNE 569 - SCIENCE AND APPLICATIONS OF CORROSION SCIENCE AND ENGINEERING**Short Title:** CORROSION SCIENCE & ENGINEERING**Department:** Materials Science & NanoEng**Grade Mode:** Standard Letter**Course Type:** Lecture**Credit Hours:** 3**Restrictions:** Enrollment is limited to Graduate level students.**Course Level:** Graduate**Prerequisite(s):** MSCI 301 or MSNE 301

Description: Students will learn basics of corrosion science of metals and alloys exposed to different classes of conditions, prevalent forms of corrosion, consequences of corrosion and corrosion mitigation approaches in a range of industries. Discussion of nano science aspects related to corrosion control in industry will be included.

MSNE 570 - SENIOR DESIGN THESIS PROJECT**Short Title:** SENIOR DESIGN THESIS PROJECT**Department:** Materials Science & NanoEng**Grade Mode:** Standard Letter**Course Type:** Independent Study**Credit Hours:** 2**Restrictions:** Enrollment is limited to Graduate level students.**Course Level:** Graduate

Description: A design project in the materials science field will be undertaken by the student in close collaboration with at least one materials science faculty member.

MSNE 571 - SENIOR DESIGN THESIS PROJECT**Short Title:** SENIOR DESIGN THESIS PROJECT**Department:** Materials Science & NanoEng**Grade Mode:** Standard Letter**Course Type:** Independent Study**Credit Hours:** 2**Restrictions:** Enrollment is limited to Graduate level students.**Course Level:** Graduate

Description: A design project in the materials science field will be undertaken by the student in close collaboration with at least one materials science faculty member. Instructor Permission Required.

MSNE 580 - MICROSCOPY METHODS IN MATERIALS SCIENCE**Short Title:** MICROSCOPY METHODS**Department:** Materials Science & NanoEng**Grade Mode:** Standard Letter**Course Type:** Lecture/Laboratory**Credit Hours:** 3**Restrictions:** Enrollment is limited to Graduate level students.**Course Level:** Graduate

Description: This course covers theory and applications of electron microscopy techniques with an emphasis on transmission and scanning transmission electron microscopy (TEM, STEM). Topics include modern instrumentation and hardware, electron diffraction, imaging modes, tomography, and spectroscopy (energy dispersive x-ray spectroscopy (EDS), electron-energy loss spectroscopy (EELS), cathodoluminescence (CL)). Previous experience with electron microscopes recommended. Can be taken alone or concurrently with lab course MSNE 582. Instructor Permission Required. Cross-list: CHEM 580.

MSNE 581 - MICRO AND NANO HEAT TRANSPORT METHODOLOGIES AND DESIGN**Short Title:** MICRO & NANO HEAT TRANSPORT**Department:** Materials Science & NanoEng**Grade Mode:** Standard Letter**Course Type:** Lecture**Credit Hours:** 3

Restrictions: Enrollment is limited to students with a major in Mechanical Engineering or Materials Science & NanoEng. Enrollment is limited to Graduate level students.

Course Level: Graduate**Prerequisite(s):** MECH 481

Description: A thorough explanation of the methodologies used for solving conduction, convection and radiation heat transport problems in macro, micro and nanosystems. Phonon, photon and electron transfer fundamentals. Equilibrium Statistics. Basic kinetic theory and transport properties of ideal gases. Microchannel heat transfer. Nanofluid heat transfer. Non-Fourier heat Conduction. Boltzmann transport equation. Molecular dynamics and lattice dynamics numeric methods. Applications and design problems in contemporary technologies. To be taught alternating years for MECH and MSNE Seniors and Graduate students. Cross-list: MECH 581.

MSNE 582 - ELECTRON MICROSCOPY CENTER LAB**Short Title:** ELECTRON MICROSCOPY CENTER LAB**Department:** Materials Science & NanoEng**Grade Mode:** Standard Letter**Course Type:** Laboratory**Credit Hour:** 1**Restrictions:** Enrollment is limited to Graduate level students.**Course Level:** Graduate**Corequisite:** MSNE 580**Description:** Hands-on laboratory using the instruments in the electron microscopy center. The students will gain the knowledge necessary to operate the instruments and analyze data independently. Must be taken concurrently with MSNE 580. Instructor Permission Required. Cross-list: CHEM 582.**MSNE 593 - INTRODUCTION TO POLYMER PHYSICS AND ENGINEERING****Short Title:** POLYMER PHYSICS**Department:** Materials Science & NanoEng**Grade Mode:** Standard Letter**Course Type:** Lecture**Credit Hours:** 3**Restrictions:** Enrollment is limited to Graduate level students.**Course Level:** Graduate**Prerequisite(s):** CHEM 211 and CHEM 212**Description:** The course focuses on demonstrating how the physical properties of polymers can be understood from simple models. Students will be introduced to the terminology and mathematics involved in the physical understanding of polymer systems. The course is intended for students who would like to gain an understanding of modern approaches to polymer physics. NOTE: Not offered every year. Cross-list: CHBE 593.**MSNE 594 - PROPERTIES OF POLYMERS****Short Title:** PROPERTIES OF POLYMERS**Department:** Materials Science & NanoEng**Grade Mode:** Standard Letter**Course Type:** Lecture**Credit Hours:** 3**Restrictions:** Enrollment is limited to Graduate level students.**Course Level:** Graduate**Prerequisite(s):** (CHEM 211 or CHEM 251) and (MATH 211 or MATH 221)**Description:** The course will introduce basic concepts in polymer science including the synthesis and chemical modification of polymers as well as physical properties of polymers. Topics include approaches to polymer synthesis, processing and characterization of polymer materials, and an introduction to mathematical models applied to describe the structure and dynamics of polymeric materials. NOTE: Offered in alternative year with MSNE 560/CHBE 560. Cross-list: CHBE 594. Repeatable for Credit.**MSNE 599 - LAB ROTATIONS AND ADVISOR SELECTION****Short Title:** LAB ROTATION ADVISOR SELECTION**Department:** Materials Science & NanoEng**Grade Mode:** Satisfactory/Unsatisfactory**Course Type:** Laboratory**Credit Hour:** 1**Course Level:** Graduate**Description:** Open to first year doctoral students. Students will rotate through three research groups to familiarize themselves with the research projects and environment offered by each group, and complete the advisor selection form at the end of the rotations. Department Permission Required.**MSNE 609 - RISK ASSESSMENT AND ASSET INTEGRITY IN OIL AND GAS PRODUCTION AND REFINING OPERATIONS I****Short Title:** OIL AND GAS ASSET INTEGRITY I**Department:** Materials Science & NanoEng**Grade Mode:** Standard Letter**Course Type:** Lecture**Credit Hours:** 3**Restrictions:** Enrollment is limited to Graduate level students.**Course Level:** Graduate**Description:** The course integrates risk assessment and mitigation, asset integrity management, corrosion control and materials selection across the oil and gas value chain, from production to refining and retail. The full course covers 2 semesters. Session "I," to be delivered in the Spring 2017 semester. Session "II" will be delivered in the Fall 2017 semester. Instructor Permission Required. Cross-list: CHBE 609.**MSNE 613 - SPECIAL TOPICS I****Short Title:** NANOMATERIALS FOR ENERGY 1**Department:** Materials Science & NanoEng**Grade Mode:** Standard Letter**Course Type:** Lecture**Credit Hours:** 1-9**Restrictions:** Enrollment is limited to Graduate level students.**Course Level:** Graduate**Description:** Engineered Nanomaterials for Sustainable Energy provides a working knowledge of the synthesis, processing and applications of nanomaterials for energy production (conventional and renewable energy sources) for energy storage (mechanical, electrical and chemical storage). The health and safety aspects of nanomaterials will also be discussed. This will be a two credit hour course. Repeatable for Credit.**MSNE 614 - SPECIAL TOPICS II****Short Title:** SPECIAL TOPICS II**Department:** Materials Science & NanoEng**Grade Mode:** Standard Letter**Course Type:** Lecture**Credit Hours:** 1-9**Restrictions:** Enrollment is limited to Graduate level students.**Course Level:** Graduate**Description:** The course covers a wide spectrum of the chemistry of nanomaterials and nanostructures, with emphasis on principles, synthesis, properties, characterization and applications. Students will learn to evaluate particle size and shape distributions, predict stability of nanoparticles and analyze the size-dependent properties of nanoparticles using different advanced techniques. This will be a 3-credit hour course. Repeatable for Credit.**MSNE 615 - SPECIAL TOPICS III****Short Title:** SPECIAL TOPICS III**Department:** Materials Science & NanoEng**Grade Mode:** Standard Letter**Course Type:** Lecture**Credit Hours:** 1-9**Restrictions:** Enrollment is limited to Graduate level students.**Course Level:** Graduate**Description:** This graduate level course is an advanced lecture on the use and the exploitation of various linear and non-linear optical spectroscopy techniques such as resonant Raman scattering, Rayleigh scattering, two-photon and time resolved transient absorptions, for the characterization of semiconductor and metallic nanomaterials & nanostructures. This will be a 1 credit hour course. Repeatable for Credit.

MSNE 616 - AUTOMOTIVE ENGINEERING: MATERIALS AND DYNAMICS**Short Title:** AUTOMOTIVE ENGINEERING**Department:** Materials Science & NanoEng**Grade Mode:** Standard Letter**Course Type:** Lecture**Credit Hours:** 1-3**Restrictions:** Enrollment is limited to Graduate level students.**Course Level:** Graduate

Description: Discussion of the engineering and materials technology that is involved in modern automotive design. Topics include: chassis design and construction; composite design and fabrication; aerodynamics and ground effects; suspension dynamics; performance technology. External expert speakers will provide a real-world perspective. Course will only be offered with sufficient demand. Check with the instructor. Instructor Permission Required. Repeatable for Credit.

MSNE 617 - AUTOMOTIVE ENGINEERING: LAB**Short Title:** AUTOMOTIVE ENGINEERING: LAB**Department:** Materials Science & NanoEng**Grade Mode:** Standard Letter**Course Type:** Laboratory**Credit Hours:** 1-3**Restrictions:** Enrollment is limited to Graduate level students.**Course Level:** Graduate

Description: Laboratory application of engineering skills towards the materials technology and dynamics of chassis design, composite design, and fabrication, aerodynamics, and performance technology. Not offered every year. Instructor Permission Required. Recommended Prerequisite(s): MSCI 616 or MSNE 616. Repeatable for Credit.

MSNE 618 - RISK ASSESSMENT AND ASSET INTEGRITY IN OIL AND GAS PRODUCTION AND REFINING OPERATIONS II**Short Title:** OIL AND GAS ASSET INTEGRITY II**Department:** Materials Science & NanoEng**Grade Mode:** Standard Letter**Course Type:** Lecture**Credit Hours:** 3**Restrictions:** Enrollment is limited to Graduate level students.**Course Level:** Graduate

Description: The course integrates risk assessment and mitigation, asset integrity management, corrosion control and materials selection across the oil and gas value chain, from production to refining and retail. The full course covers 2 semesters. Session "I," to be delivered in the Spring 2017 semester. Session "II" will be delivered in the Fall 2017 semester. Instructor Permission Required. Cross-list: CHBE 618.

MSNE 621 - M.M.S. RESEARCH PROJECT I**Short Title:** M.M.S. RESEARCH PROJECT I**Department:** Materials Science & NanoEng**Grade Mode:** Standard Letter**Course Type:** Research**Credit Hours:** 3**Restrictions:** Enrollment is limited to Graduate level students.**Course Level:** Graduate

Description: This is the first part of the M.M.E. research project course. The faculty advisor, taking into account the background and research interests of the student as well as the research interests of the faculty advisor, will determine the contents. Course requirements will include a final report. Instructor Permission Required.

MSNE 622 - M.M.S. RESEARCH PROJECT II**Short Title:** M.M.S. RESEARCH PROJECT II**Department:** Materials Science & NanoEng**Grade Mode:** Standard Letter**Course Type:** Research**Credit Hours:** 3**Restrictions:** Enrollment is limited to Graduate level students.**Course Level:** Graduate

Description: This is the second part of the M.M.E. research project and continuation of MSNE 621. Course requirements will include a final report. Instructor Permission Required. Repeatable for Credit.

MSNE 650 - NANOMATERIALS AND NANOMECHANICS**Short Title:** NANOMATERIALS & NANOMECHANICS**Department:** Materials Science & NanoEng**Grade Mode:** Standard Letter**Course Type:** Lecture**Credit Hours:** 3**Restrictions:** Enrollment is limited to Graduate level students.**Course Level:** Graduate

Description: The primary goal of this course is to introduce important current developments in the field of nanomaterials and nanomechanics. The course will discuss synthesis and characterization of nanomaterials, the behaviors especially mechanical behaviors in the broad sense of such materials, and their technological applications. The basic physics and fundamental mechanisms responsible for nanoscale induced changes in properties will be stressed.

MSNE 677 - SPECIAL TOPICS**Short Title:** SPECIAL TOPICS**Department:** Materials Science & NanoEng**Grade Mode:** Standard Letter**Course Type:** Internship/Practicum, Seminar, Lecture, Laboratory**Credit Hours:** 1-4**Restrictions:** Enrollment is limited to Graduate or Visiting Graduate level students.**Course Level:** Graduate

Description: Topics and credit hours vary each semester. Contact department for current semester's topic(s). Repeatable for Credit.

MSNE 800 - RESEARCH AND THESIS**Short Title:** RESEARCH AND THESIS**Department:** Materials Science & NanoEng**Grade Mode:** Satisfactory/Unsatisfactory**Course Type:** Research**Credit Hours:** 1-12**Restrictions:** Enrollment is limited to students with a major in Materials Science & NanoEng. Enrollment is limited to Graduate level students.**Course Level:** Graduate**Description:** Repeatable for Credit.

Description and Code Legend

Note: Internally, the university uses the following descriptions, codes, and abbreviations for this academic program. The following is a quick reference:

Course Catalog/Schedule

- Course offerings/subject code: MSNE

Department Description and Code

- Materials Science and NanoEngineering: MSNE

Undergraduate Degree Descriptions and Codes

- Bachelor of Arts degree: BA
- Bachelor of Science in Materials Science and NanoEngineering degree: BSMSNE

Undergraduate Major Code and Description

- Major in Materials Science and NanoEngineering: MSNE

Graduate Degree Descriptions and Codes

- Master of Materials Science and NanoEngineering degree: MMSNE
- Master of Science degree: MS
- Doctor of Philosophy degree: PhD

Graduate Degree Program Description and Code

- Degree Program in Materials Science and NanoEngineering: MSNE

CIP Code and Description ¹

- MSNE Major/Program: CIP Code/Title: *15.1601 - Nanotechnology*

¹ Classification of Instructional Programs (CIP) 2010 Codes and Descriptions from the National Center for Education Statistics: <https://nces.ed.gov/ipeds/cipcode/>