

# Department of Civil and Mechanical Engineering

UMKC 2007-08 Graduate and Professional Catalog (1.0)

June 12, 2007



# Contents

Department of Civil and Mechanical Engineering . . . . .	5
Civil Engineering . . . . .	5
Program Description . . . . .	5
Career Opportunities . . . . .	5
Master of Science in Civil Engineering . . . . .	5
Admission . . . . .	5
Assistantships . . . . .	6
Graduate Degree Options and Requirements . . . . .	6
Transfer Credits . . . . .	6
Civil Engineering Specialty Areas . . . . .	6
Advising and Registration . . . . .	6
Academic Standing . . . . .	6
Graduation . . . . .	6
Fast Track Civil Engineering Program . . . . .	6
Doctoral Studies in Civil Engineering . . . . .	6
Mechanical Engineering . . . . .	6
Program Description . . . . .	7
Career Opportunities . . . . .	7
Master of Science in Mechanical Engineering . . . . .	7
Admission . . . . .	7
Assistantships . . . . .	7
Graduate Degree Options and Requirements . . . . .	7
Transfer Credits . . . . .	8
Mechanical Engineering Specialty Areas . . . . .	8
Advising and Registration . . . . .	8
Academic Standing . . . . .	8
Graduation . . . . .	8
Fast Track Mechanical Engineering Program . . . . .	8
Doctoral Studies in Mechanical Engineering . . . . .	8
Courses . . . . .	8
Civil Engineering (CE) . . . . .	8
Mechanical Engineering (ME) . . . . .	9



# Department of Civil and Mechanical Engineering

Robert H. Flarsheim Science and Technology Hall  
5110 Rockhill Road, Room 352  
(816) 235-5550  
Fax: (816) 235-1260  
cme@umkc.edu  
<http://www.sce.umkc.edu/cme/cme.shtml>

## Mailing Address

University of Missouri-Kansas City  
Civil and Mechanical Engineering Department  
352 Flarsheim Hall  
5100 Rockhill Road  
Kansas City, MO 64110-2499

## Department Chair:

Mark F. McClernon

## Professors:

Bryan R. Becker, Anil Misra (director of civil engineering)

## Associate Professors:

Mark F. McClernon (department chair and director of mechanical engineering), Deborah J. OBannon, Jerry R. Richardson

## Assistant Professors:

Brian A. Fricke, Trent M. Guess, Greg King, Pei-Wei Lin, Ganesh Thiagarajan

## Assistant Teaching Professor:

Katherine H. Bloemker

## Adjunct Faculty:

Lee Azimi Zonooz, Max Bona, Mike Carlson, David Christianson, Larry Drbal, Bob Hanlin, Steve Hague, Mike Kelly, Bob Lambrechts, Forrest G. Lowe, Dan Justice, Thomas Kimes, Jim Mahoney, Pete Scheuer, Walter Rychlewski, Scott Yerganian

## Professors Emeriti:

C. Quinton Bowles, George F.W. Hauck, Rudolph L. Leutzinger Sr., Donald R. Smith, William E. Stewart Jr.

## Civil Engineering

The American Society of Civil Engineers (ASCE) defines civil engineering as “the profession in which a knowledge of the mathematical and physical sciences gained by study, experience and practice is applied with judgment to develop ways to utilize economically, the materials and forces of nature for the progressive well-being of humanity in creating, improving and protecting the environment, in providing facilities for community living, industry and transportation and in providing structures for the use of humankind”. The CE program aims to prepare students with a breadth and depth in the technical knowledge so that they can work immediately in most areas of the profession including geotechnical engineering; hydraulics, hydrology, water resources; structural engineering; and transportation/traffic engineering.

## Program Description

The program offers the bachelors degree and the masters degree in civil engineering and participates in the UMKC Interdisciplinary Ph.D. program. The Bachelor of Science in Civil Engineering is accredited by the Engineering Accreditation Commission of

ABET  
111 Market Place, suite 1050  
Baltimore, MD 21202-4012  
(410) 347-7700  
<http://www.abet.org>

The Master of Science in Civil Engineering has both thesis and non-thesis options. Students interested in pursuing a doctoral degree in civil engineering may select engineering as a discipline when applying for admission into the Interdisciplinary Ph.D. program.

To accommodate part-time and working students, most of the undergraduate classes are conducted in the afternoons and graduate classes are conducted in the evenings.

The civil engineering program has a rich history in Kansas City. The University of Kansas City offered a General Engineering degree in the 1950s. The masters program in civil engineering was started in 1964 and later the undergraduate program was added in the early 1970s. Since 1977, the undergraduate program in civil engineering has been independently accredited by ABET. The program became a part of the School of Computing and Engineering (SCE) in January 2001 and is housed in Flarsheim Hall.

## Career Opportunities

Kansas City is one of the premier centers of engineering design in the country. Numerous civil infrastructure design and construction firms with national and international reputation are headquartered in Kansas City. This offers a unique opportunity to our students, many of whom participate actively as interns or as employees with these firms during the course of their study, thereby, getting a balanced blend of course work and practical experience.

Job opportunities abound for engineering majors. In terms of starting salaries and the number of job offers, engineering graduates compare favorably with all other graduates. In addition, the civil engineering curriculum at UMKC equips the graduate with the analytic decision-making skills necessary to pursue diverse technical, managerial and entrepreneurial career opportunities.

## Master of Science in Civil Engineering

The civil engineering program offers graduate students an opportunity to get a state-of-the-art education in dynamic, challenging and professionally significant specialty areas. Masters students are allowed to take up to half of their credits in other fields, such as management, geosciences etc., to encourage them to broaden their education beyond the civil engineering field. To accommodate part-time and working students, graduate classes are conducted in the evenings. There are three degree options for earning a master's in civil engineering: coursework only, project or thesis options. For further information call (816) 235-5550 or e-mail [sce@umkc.edu](mailto:sce@umkc.edu).

## Admission

A baccalaureate degree in civil engineering or related disciplines with GPA of at least 3.0 in the last 60 hours of undergraduate engineering coursework is required. Pre-program requirements may be specified in case the Bachelors degree is in a discipline different than that to which the candidate is applying.

The following documents are required for admission consideration:

1. Application for admission.
2. Official transcripts of all college coursework.
3. TOEFL score (for international students only). A minimum test score of 550 is needed for acceptance in any graduate engineering program.
4. Three letters of recommendation from professors at previous institutions or mentors at work.

5. Official results of the Graduate Record Exam (GRE) are required for all applicants. A cumulative score of at least 1600 (verbal + quantitative + analytical) with 85 percent on the quantitative portion is required. GRE requirements may be waived for applicants with a baccalaureate from an ABET accredited program who have passed the Fundamentals of Engineering (FE) exam and have work experience.

Conditional admission may be granted when the minimum GPA and GRE requirements are not met but other indicators promise applicants success in the program. To be fully admitted as a regular masters degree seeking student, the candidate must obtain a grade of "B" or better in the first nine hours of coursework and submit a satisfactory GRE score within the first semester of their program.

### International Students

International student apply using the international application form and return the application, along with required supporting materials, to the University of Missouri-Kansas City, Office of International Student Affairs.

### Assistantships

The school has numerous assistantship positions available each semester. Typically awards are for quarter-time or half-time support, and may include tuition fee waivers.

### Graduate Degree Options and Requirements

- Master of Science with *coursework only* requires the completion of a minimum of 30 credit hours of graduate coursework (300-level or higher). The graduate coursework must include at least 18 credit hours of 5500/5600-level courses.
- Master of Science with *project* requires the completion of a minimum of 30 credit hours, which includes 27 credit hours of graduate coursework (300-level or higher) and three credit hours of independent project (CE 5500). At least 18 credit hours must be at the 5500/5600-level. The candidate must submit a report prepared per the advisers guidelines and present the project work in front of a three-member project examining committee.
- Master of Science with *thesis* requires the completion of a minimum of 30 credit hours, which includes 24 credit hours of approved graduate coursework (300-level or higher) and six credit hours of thesis work (CE 5599). At least 18 credit hours must be at the 5500/5600-level. The candidate must submit a thesis prepared per the graduate school guidelines and orally defend the thesis work in front of a three-member thesis examining committee.

In addition, half of the required credit hours may be earned in other fields, such as management, geosciences etc., to allow students to broaden their education beyond the civil engineering field.

### Transfer Credits

- With permission of the student's graduate adviser, up to six credit hours of transfer graduate coursework may be transferred from other non-University of Missouri institutions.
- With permission of the student's graduate adviser, up to 14 credit hours of transfer graduate coursework may be transferred from other University of Missouri institutions.
- However, at least 16 credit hours of graduate coursework must be taken at UMKC.

### Civil Engineering Specialty Areas

Research and study are available in the following specialties:

- Construction engineering
- Environmental engineering
- Geotechnical engineering
- Hydraulics and hydrology
- Materials engineering
- Structural engineering
- Transportation engineering

### Construction Engineering

#### Advising and Registration

The civil engineering program assigns a faculty member to be the students academic adviser throughout the duration of their study. Students are required to meet with their faculty adviser every semester prior to registering for the following semester. The faculty adviser guides the student in selecting courses that are necessary for the completion of the degree requirements and answers questions regarding elective course programs and options. During the advising period, the faculty adviser determines whether the student is meeting degree requirements by reviewing the program advisement form. Any deviations by a student are corrected immediately. Specific information regarding registration is found in the UMKC Class Schedule and on the UMKC Web site.

#### Academic Standing

A graduate student must maintain a cumulative GPA of 3.0 for all graduate coursework taken during the course of graduate studies. Should the cumulative GPA fall below 3.0, the student will be placed on probation. A student on probation must bring the cumulative GPA to a 3.0 by the end of the next semester or face possible dismissal.

#### Graduation

Students should apply for graduation when they register for their final semester of coursework. All students must complete and file with the Department Office both the UMKC Application for Graduation form and the Departmental Program of Study form. Students selecting the *project* or *thesis* option must also file a Departmental Report of the Masters Examining Committee form. Students selecting the *thesis* option must file a Masters Thesis Report form and have their thesis approved by the UMKC Graduate School.

#### Fast Track Civil Engineering Program

See the Fast Track section under Civil Engineering in the undergraduate catalog for information about the Fast Track Civil Engineering Program.

### Doctoral Studies in Civil Engineering

Civil Engineering participates in the Interdisciplinary Ph.D. program of the University of Missouri-Kansas City as part of the engineering discipline. Students interested in pursuing a doctoral degree in civil engineering may select engineering as a discipline when applying for admission into the Interdisciplinary Ph.D. Program. See the School of Graduate Studies section of this catalog for general and discipline-specific admission requirements and regulations for Interdisciplinary Ph.D. study with engineering as one of the desired disciplines.

### Mechanical Engineering

Mechanical engineering (ME) is one of the broadest of the engineering disciplines, therefore, mechanical engineers are the generalists of the engineering profession. Mechanical engineers design, construct, test and operate many types of

mechanical, thermal and biological devices. They are involved in almost every industry, including aerospace, automotive, bioengineering, communications, electronics, energy, food processing, HVAC, manufacturing, power generation and refrigeration, as well as business, government and academia. The ME program aims to prepare students with a breadth and depth in technical knowledge so that they can work immediately in most areas of the profession.

### Program Description

The program offers the bachelors degree and the masters degree in mechanical engineering and participates in the UMKC Interdisciplinary Ph.D. program. The Bachelor of Science in Mechanical Engineering is accredited by the Engineering Accreditation Commission of

ABET  
111 Market Place, suite 1050  
Baltimore, MD 21202-4012  
(410) 347-7700  
<http://www.abet.org>

The Master of Science in Mechanical Engineering has both thesis and non-thesis options. Students interested in pursuing a doctoral degree in mechanical engineering may select engineering as a discipline when applying for admission into the Interdisciplinary Ph.D. program.

To accommodate part-time and working students, most of the undergraduate classes are conducted in the afternoons and graduate classes are conducted in the evenings.

The mechanical engineering program has a rich history in Kansas City. The University of Kansas City offered a General Engineering degree in the 1950s. The masters program in mechanical engineering was started in 1964 and later the undergraduate program was added in the early 1970s. Since 1977 the undergraduate program in mechanical engineering has been independently accredited by ABET. The program became a part of the School of Computing and Engineering (SCE) in January 2001 and is housed in Flarsheim Hall.

### Career Opportunities

Kansas City is one of the premier engineering centers in the country. Numerous engineering and manufacturing firms with national and international reputation are headquartered in Kansas City. This offers a unique opportunity to our students, many of whom participate actively as interns or as employees with these firms during the course of their study, thereby getting a balanced blend of coursework and practical experience.

Job opportunities abound for engineering majors. In terms of starting salaries and the number of job offers, engineering graduates compare favorably with all other graduates. In addition, the mechanical engineering curriculum at UMKC equips the graduate with the analytic decision-making skills necessary to pursue diverse technical, managerial and entrepreneurial career opportunities.

### Master of Science in Mechanical Engineering

The mechanical engineering program offers graduate students an opportunity to get a state-of-the-art education in dynamic, challenging and professionally significant specialty areas. Masters students are allowed to take up to half of their credits in other fields, such as management, mathematics, etc., to encourage them to broaden their education beyond the mechanical engineering field. To accommodate part-time and working students, graduate classes are conducted in the evenings. There are three degree options for earning a master's

in mechanical engineering: coursework only, project or thesis options. For further information call (816) 235-5550 or e-mail [see@umkc.edu](mailto:see@umkc.edu).

### Admission

A baccalaureate degree in mechanical engineering or related disciplines with a GPA of at least 3.0 in the last 60 hours of undergraduate engineering coursework is required. Pre-program requirements may be specified in case the Bachelors degree is in a discipline different than that to which the candidate is applying.

The following documents are required for admission consideration:

1. Application for admission.
2. Official transcripts of all college coursework.
3. TOEFL score (for international students only). A minimum test score of 550 is needed for acceptance in any graduate engineering program.
4. Three letters of recommendation from professors at previous institutions or mentors at work.
5. Official results of the Graduate Record Exam (GRE) are required for all applicants. A cumulative score of at least 1600 (verbal + quantitative + analytical) with 85 percent on the quantitative portion is required. GRE requirements may be waived for applicants with a baccalaureate from an ABET accredited program who have passed the Fundamentals of Engineering (FE) exam and have work experience.

Conditional admission may be granted when the minimum GPA and GRE requirements are not met, however, other indicators promise applicants success in the program. To be fully admitted as a regular masters degree seeking student, the candidate must obtain a grade of "B" or better in the first nine hours of coursework and submit a satisfactory GRE score within the first semester of their program.

### International Students

Use the international application form and return the application, along with required supporting materials, to the University of Missouri-Kansas City, Office of International Student Affairs.

### Assistantships

The school has numerous assistantship positions available each semester. Typically awards are for quarter-time or half-time support, and may include tuition fee waivers.

### Graduate Degree Options and Requirements

- Master of Science with *coursework only* option requires the completion of a minimum of 30 credit hours of graduate coursework (300-level or higher). The graduate coursework must include at least 18 credit hours of 5500/5600-level courses.
- Master of Science with *project* requires the completion of a minimum of 30 credit hours, which includes 27 credit hours of graduate coursework (300-level or higher) and three credit hours of independent project (ME 5500). At least 18 credit hours must be at the 5500/5600-level. The candidate must submit a report prepared per the advisers guidelines and present the project work in front of a three-member project examining committee.
- Master of Science with *thesis* option requires the completion of a minimum of 30 credit hours of graduate coursework (300-level or higher). The graduate coursework must include at least 24 credit hours of approved graduate coursework (300-level or higher) and

six credit hours of thesis work (ME 5599). At least 18 credit hours must be at the 5500/5600-level. The candidate must submit a thesis prepared per the graduate school guidelines and orally defend the thesis work in front of a three-member thesis examining committee.

In addition, half of the required credit hours may be earned in other fields, such as management, mathematics, etc., to allow students to broaden their education beyond the mechanical engineering field.

### Transfer Credits

- With permission of the student's graduate adviser, up to six credit hours of transfer graduate coursework may be transferred from other non-University of Missouri institutions.
- With permission of the student's graduate adviser, up to 14 credit hours of transfer graduate coursework may be transferred from other University of Missouri institutions.
- However, at least 16 credit hours of graduate coursework must be taken at UMKC.

### Mechanical Engineering Specialty Areas

Research and study are available in the following specialties:

- Biomaterials
- Biomechanics
- Biothermics
- Dynamics and controls
- Energy systems
- Fluid dynamics
- Heat transfer
- Manufacturing
- Material science

### Advising and Registration

The mechanical engineering program assigns a faculty member to be the students academic adviser throughout the duration of their study. Students are required to meet with their faculty adviser every semester prior to registering for the following semester. The faculty adviser guides the student in selecting courses that are necessary for the completion of the degree requirements and answers questions regarding elective course programs and options. During the advising period, the faculty adviser determines whether the student is meeting degree requirements by reviewing the program advisement form. Any deviations by a student are corrected immediately. Specific information regarding registration is found in the UMKC Class Schedule and on the UMKC Web site.

### Academic Standing

A graduate student must maintain a cumulative GPA of 3.0 for all graduate coursework taken during the course of graduate studies. Should the cumulative GPA fall below 3.0, the student will be placed on probation. A student on probation must bring the cumulative GPA to a 3.0 by the end of the next semester or face possible dismissal.

### Graduation

Students should apply for graduation when they register for their final semester of coursework. All students must complete and file with the Department Office both the UMKC Application for Graduation form and the Departmental Program of Study form. Students selecting the *project* or *thesis* option must also file a Departmental Report of the Masters Examining Committee form. Furthermore, students selecting the *thesis* option must file a Masters Thesis Report form and have their thesis approved by the UMKC Graduate School.

### Fast Track Mechanical Engineering Program

See the Fast Track section under Mechanical Engineering in the undergraduate catalog for information about the Fast Track Mechanical Engineering Program.

### Doctoral Studies in Mechanical Engineering

Mechanical Engineering participates in the Interdisciplinary Ph.D. program of the University of Missouri-Kansas City as part of the engineering discipline. Students interested in pursuing a doctoral degree in mechanical engineering may select engineering as a discipline when applying for admission into the Interdisciplinary Ph.D. Program. See the School of Graduate Studies section of this catalog for general and discipline-specific admission requirements and regulations for Interdisciplinary Ph.D. study with engineering as one of the desired disciplines.

### Civil Engineering (CE) Courses

**5500 Problems (1-6).** Supervised investigation in civil engineering to be presented in the form of a report. Prerequisite: Graduate standing.

**5501 Advanced Topics In Civil Engineering (1-3).** Current technical developments in civil engineering.

**5501L Advanced Topics In Civil Engineering (1-3).**

**5525 Advanced Reinforced Concrete Design (3).** Designed of eccentric and combine footings, retaining walls, two way floorslabs, design and analysis of multistory building frames, and introduction of prestressed concrete. Prerequisite: CE 422

**5536 Advanced Soil Mechanics (3).** Theoretical soil mechanics as applied to solution of specific engineering problems. Prerequisite: CE 335.

**5544 Unit process Laboratory for Water and Wastewater Treatment (3).** Typical chemical and physical relationships are applied to unit processes of water and wastewater. Troubleshooting for operation problems is emphasized. The class has significant laboratory/field component. Prerequisite: CE342

**5545 Environmental Engineering Microbiology (3).** Theory and application of fundamental principles of microbiology, toxicology, ecology, and aquatic biology of the microorganisms of importance to environmental engineers.

**5546 Limnology (3).** A survey of the physical, biological, and chemical issues important in surface fresh waters. Includes carbonate chemistry, algal assay and Thermocline analysis. Prerequisites: Chem 211 and Math 345

**5552 Hydraulics of Open Channels (3).** The fundamentals of free surface flow are investigated. This includes the study of the principles of continuity, Momentum and Energy; Specific Energy, Discharge and Force; Steady-Gradually varied and Steady, Rapidly Varied Flow; Hydraulic Structures; and, the derivation of, and general methods for solution of the 1-dimensional, unsteady St. Venant Equations. Prerequisite: CE 351

**5553 Hydraulics and Variability of Rivers (3).** This course investigates the fundamental concepts of alluvial channel behavior including stream channel evolution and change due to natural and man-induced modifications to streams and watersheds. Numerous case studies of river behavior and studied from the perspective of hydraulics, geomorphology and sediment transport. Prerequisite: CE355

**5554 River Stability and Scour (3).** With over 500,000 bridge over water, a significant number are damaged or destroyed by floods annually. This is a study of the theory of and fundamentals methods and procedures recommended to evaluate and analyze stream stability and scour at bridges. Specific topics include Bridge hydraulics; stream stability bridge piers and abutments; hydraulic modeling of floods; and, countermeasures for protection of bridge infrastructure. Prerequisite: CE355 or instructor approval.

**5555 Highway Hydraulics and Sediment Transport (3).** The study of sediment transport in rivers, specifically in the vicinity of highway and railroad bridge encroachments. The understanding of the relationship between sediment transport and the fundamentals of fluvial geomorphology. Computation of sediment transport and sediment transport modeling. Prerequisite: CE 355

**5582 Advanced Traffic Engineering (3).** This course covers the review of traffic flow characteristics, the field survey practices and studies, traffic signal designs, freeway operation, and the introduction to Intelligent Traffic Systems (ITS) Prerequisites: CE481 and CE319

**5599 Thesis Research (1-6).** Independent investigation in the field of civil engineering to be presented in the form of a thesis.

**5601 Doctoral Topics In Civil Engineering (1-3).** Current technical developments in civil engineering.

**5601B Advanced Topics In Civil Engineering (1-3).**

**5601X Advanced Topics In Civil Engineering (1-3).**

**5602 Directed Reading In Civil Engineering (1-3).** Faculty supervised readings course. Prerequisite: Graduate standing. Offered: Fall and winter.

**5607 Numerical Methods In Engineering (3).** Classification and numerical solution of engineering problems—ordinary and partial differential equations, algebraic equations. Includes initial, boundary, eigen-# and characteristic-value problems. Prerequisite: Math 345.

**5621 Continuum Mechanics (3).** Introductory course in the mechanics of continuous media. Basic concepts of stress, strain, constitutive relationships; conservation laws are treated using Cartesian tensor notation. Examples from both solid and fluid mechanics investigated. (Same as ME 621) Prerequisites: CE 351, Math 345, and CE 276

**5622 Theory Of Elasticity (3).** Stress and strain at a point. General equations of elasticity. Plane stress, plain strain problems; torsion of prismatic bars. Energy methods. (Same as ME 622) Prerequisite: CE 621

**5623 Theory Of Plates And Shells (3).** Bending of plates with various loading and boundary conditions. Deformations, stresses in thin shells. (Same as ME 623) Prerequisite: CE 621

**5624 Theory Of Elastic Stability (3).** Buckling of columns, beams, rings, curved bars, thin plates, shells. (Same as ME 624) Prerequisite: CE 621

**5645 Water Quality Modeling (3).** Derivation and application of models for describing oxygen budget, nutrient exchange, and biological productivity in streams, lakes and estuaries. Prerequisite: CE 342.

**5646 Physiochemical Treatment Processes (3).** Fundamental principles, analysis and modeling of physical and chemical processes for water and wastewater treatment. Prerequisite: CE 342.

**5647 Biochemical Treatment Processes (3).** Biochemical principles, kinetic models and energy considerations in the design of biological wastewater treatment processes. Prerequisite: CE 342.

**5648 Environmental Engineering Practicum (3).** Numerical water quality modeling of actual site data for wasteload allocation.

**5649 Design Of Water And Wastewater Treatment Facilities (3).**

Development of design criteria and their application to the design of water and wastewater treatment facilities. Prerequisite: CE 342.

**5651 Fundamentals Of Fluid Mechanics (3).** Fundamentals of fluid motion, lecture and laboratory. Instrumentation, technique and analysis for experimental studies in fluid mechanics.

**5656 Advanced Hydraulic Engineering (3).** Rapidly varied flow and design of transition structures. Hydraulic design of spillways, reservoirs and related structures.

**5676 Finite Element Methods (3).** The concepts and fundamentals of the finite element method with applications to problems in solid and fluid mechanics. Prerequisite: ME 486 or CE 421.

**5679 Dynamics Of Structures (3).** Study of the dynamic behavior of structures. Analysis of equivalent lumped parameter systems for the design of structures in a dynamic environment. (Same as ME 679) Prerequisites: ME 484 and CE 276, or CE 421, Math 345, and ME 285

**5699 Research And Dissertation (1-9).** Doctoral dissertation research.

## Mechanical Engineering (ME) Courses

**5500 Problems (1-6).** Supervised investigation in mechanical engineering to be presented in the form of a report.

**5501 Advanced Topics In Mechanical Engineering (3).**

**5501E Advanced Topics In Mechanical Engineering (3).**

**5501F Advanced Topics In Mechanical Engineering (3).**

**5501G Advanced Topics In Mechanical Engineering (3).**

**5501H Advanced Topics In Mechanical Engineering (3).**

**5501HP Advanced Topics In Mechanical Engineering (3).**

**5501L Advanced Topics In Mechanical Engineering (3).**

**5501M Advanced Topics In Mechanical Engineering (3).**

**5501N Advanced Topics In Mechanical Engineering (3).**

**5501P Advanced Topics In Mechanical Engineering (3).**

**5501PL Advanced Topics In Mechanical Engineering (3).**

**5501R Advanced Topics In Mechanical Engineering (3).**

**5501T Advanced Topics In Mechanical Engineering (1-3).**

**5504 Advanced Metallurgy Principles (3).** Advanced treatment of physical metallurgy principles to provide a theoretical understanding of engineering materials. Prerequisite: ME 324.

**5505 Imaging Techniques In Materials Science (3).** Introduction to imaging techniques, including x-rays, neutron beams, electron beams and acoustic energy, to study material properties and structure. Prerequisite: ME 324

**5533 Statistical Thermodynamics (3).** Statistical methods of evaluating thermodynamic properties. Elements of quantum mechanics, statistical mechanics and kinetic theory applied to topics of engineering thermodynamics. Prerequisites: ME 360 and ME 399

**5534 Fracture Mechanics I (3).** Mechanics of flawed structure. Concepts include Griffith theory. Barenblatt's theory, Irwin analysis, energy analysis of cracked bodies, fracture toughness testing, plane strain, plane stress, transition temperature concepts, subcritical flaw growth. Prerequisite: ME 324.

**5535 Heat Transfer-Conduction (3).** Techniques for determining temperature distribution and temperature history within solids. Prerequisite: ME 399.

**5542 Introduction To Computational Fluid Dynamics And Heat Transfer (3).** Introduction to the principles and development of the finite-difference approximations to the governing differential equations of viscous and inviscid fluid flow, as well as heat transfer. Introduction to discretization methods and the calculation of flow fields, convection, diffusion and conduction. Prerequisites: ME 399 and ME 441

**5545 Instrumentation Theory (3).** Applied theory of dynamical and energizing systems for analyzing, computing, control devices. Prerequisite: ME 362

**5558 Dynamical Theory (3).** Engineering principles and application in mathematical expression of energy, force, inertia system. Prerequisite: ME 485 and Math 345.

**5595 Microscale Heat Transfer (3).** Review of existing models. Concept of thermal lagging and the second-law admissibility. Applications to low temperatures, thermal processing of thin-film devices; amorphous materials; advanced composites. Prerequisites: ME 399.

**5599 Research (1-99).** Independent investigation in field of mechanical engineering to be presented as a thesis.

**5601 Doctoral Topics In Mechanical Engineering (3).**

**5601A Doctoral Topics In Mechanical Engineering (3).**

**5601C Doctoral Topics In Mechanical Engineering (3).**

**5601E Doctoral Topics In Mechanical Engineering (3).**

**5601G Doctoral Topics In Mechanical Engineering (3).**

**5601R Doctoral Topics In Mechanical Engineering (3).**

**5601S Doctoral Topics In Mechanical Engineering (3).**

**5601SA Doctoral Topics In Mechanical Engineering (3).**

**5603 Directed Readings In Mechanical Engineering (3).** Faculty supervised readings course. Prerequisite: Graduate Standing

**5610 Seminar (1).** Review recent investigations, projects of major importance in mechanical engineering.

**5616 Theory Of Plasticity (3).** Plastic yield conditions and stress-strain relations. Behavior of elastic-perfectly plastic members. Plain strain in plastic members. Prerequisite: ME 621; and ME 622 or instructor's consent

**5618 Advanced Dynamics (3).** Fundamental principles of advanced rigid body dynamics with applications. Special mathematical techniques including Lagrangian and Hamiltonian methods. Prerequisite: ME 385

**5621 Continuum Mechanics (3).** Introductory course in the mechanics of continuous media. Basic concepts of stress, strain, constitutive relationships; conservation laws are treated using Cartesian tensor notation. Examples from both solid and fluid mechanics investigated. Prerequisite: ME 351, MATH 345 and CE 276. Same as CE 621

**5622 Theory Of Elasticity (3).** Stress and strain at a point. General equations of elasticity. Plane stress, plain strain problems; torsion of prismatic bars. Energy methods. Same as CE 622. Prerequisite: ME 621

**5623 Theory Of Plates And Shells (3).** Bending of plates with various loading and boundary conditions. Deformations, stresses in thin shells. Same as CE 623. Prerequisite: ME 621

**5624 Theory Of Elastic Stability (3).** Buckling of columns, beams, rings, curved bars, thin plates, shells. Same as CE 624. Prerequisite: ME 621

**5627 Dynamics Of Machinery (3).** Dynamic balancing or rotating and reciprocating components of turbo-machinery and internal combustion engines. Gas torque analysis, vibration stress analysis and equivalent systems. Numerical and graphical techniques. Prerequisite: ME 484.

**5630 Boundary Layer Theory (3).** Fluid motion at high Reynolds Number. Derivation of Navier-Stokes equations and boundary layer equations. Methods of solution. Transition to turbulent flow. Completely developed turbulent flow. Prerequisite: ME 441.

**5636 Heat Transfer-Convection (3).** Principles of heat transfer by convection, review of boundary layer theory, laminar and turbulent heat transfer, temperature-dependent fluid properties, high velocity heat transfer and an introduction to mass transfer. Prerequisites: ME 399 and ME 630.

**5637 Heat Transfer-Radiation (3).** Advanced study of engineering radiation heat transfer. Concepts of electromagnetic theory. Development of thermal radiation laws from thermodynamic laws. Analysis of grey and non-grey systems with intervening gases. Study of recent literature. Prerequisites: ME 399.

**5638 Introduction To Turbulence (3).** Introduction to the physical phenomena of turbulence, supported by mathematical and statistical descriptions. Especially appropriate for engineers involved in research aspects of momentum, heat, and mass transport. Prerequisite: ME 441

**5639 Introduction To Two Phase Flow (3).** An introduction to the analysis of the mechanics and transport processes in two phase flows. Prerequisite: ME 441.

**5644 Fracture And Fatigue Prevention In Engineering Practice (3).** Practical design problems. Introduction to retrofit design, maintenance, product improvement and new design from a fatigue and fracture prevention philosophy. Fail safe and safe life designs are presented. Prerequisite: ME 534.

**5651 Computational Fluid Dynamics (3).** Principles and development of the finite-difference approximations to the governing differential equations of viscous and inviscid fluid flow. Application to selected model equations. Introduction to boundary layer and Navier-Stokes codes, and to grid generation. Prerequisite: ME 542.

**5660 Combustion (3).** Study of advanced topics in flames and combustion. Detonation and deflagrations, supersonic combustion, air pollution. Prerequisite: ME 441.

**5676 Finite Element Methods (3).** The concepts and fundamentals of the finite element method with applications to problems in solid and fluid mechanics. Prerequisite: ME 486 or CE 421. Same as CE 676

**5679 Dynamics Of Structures (3).** Study of the dynamic behavior of structures. Analysis of equivalent lumped parameter systems for the design of structures in a dynamic environment. Prerequisites: ME 484 and CE 276; or CE 421, Math 345, and ME 285

**5685 Advanced Vibration Analysis (3).** Advanced topics in vibration theory and its application to Mechanical systems. Topics include vibration analysis of multi-degree of freedom, distributed and nonlinear systems, random vibration analysis, and vibration control. Prerequisite: ME 484 or instructor's consent.

**5699 Research And Dissertation (1-9).** Doctoral dissertation research.