Tuskegee University
College of Engineering
M.S. in Chemical Engineering

Name of Degrees Offered		College	Department
Master of Science in Chemical Engineering		Engineering	Chemical Engineering
Regular Thesis Program X☐	Non-Thesis ☐	Non-Degree☐ Certificate☐ Other☐	
Dr. Nader Vahdat, Head	334-727-8978	vahdatn@mytu.tuskegee.edu	
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The Master of Science Program in Chemical Engineering (MSE) is a program housed in the Chemical Engineering Department of College of Engineering. The core faculty members are these appointed in the department 0f Chemical Engineering. Faculty members from various other disciplines including Engineering, Biology, Chemistry, Computer Science, Mathematics and Physics will also participate in the teaching of courses and advising students' theses. Several state-of-the-art research laboratories are available for students to conduct their research.

Mission: The mission of the department of Chemical Engineering and that of the proposed Master's degree program is:
To produce graduates of superior technical, professional and scientific background in chemical engineering who can perform effectively and embrace education as a lifelong endeavor.

Objectives: The objectives of the Master of Science program in Chemical Engineering are: To increase the number of STEM undergraduates receiving graduate degree in chemical engineering

Admission Requirements:

This Program is determined by the Dean of Graduate Studies and Research based on the recommendation of the faculty of the Chemical Engineering department, and is communicated to the candidates by Tuskegee University's Office of Admissions and Records. Competitive candidates for admission should have completed the verbal and quantitative parts of the Graduate Record Examination (GRE).

After the student is granted admission, he/she meets with the chair of the Chemical Engineering department for initial guidance. During the first semester of study, the student must form his/her Advisory Committee, which will consist of the major professor/advisor, and a minimum of two other faculty members.

The student must complete the following requirements to receive the Master degree in chemical engineering:

The proposed M. S. degree program in chemical engineering should be very similar to the Master's degree programs in Electrical and Mechanical Engineering in the CEPS. Therefore, it recommended that all students in the M.S. degree program in chemical engineering must:

- Complete a minimum of twenty four (24) credits of course, including twelve (12) credits of core courses, with a minimum grade point average of 3.0.
- Complete six credits of research and formally present the results of the research to the Advisory Committee, appointed by the Dean of Graduate Studies and Research, in the form of a thesis. All students pursuing the M.S. degree in chemical engineering are required to take the following core courses:

Core Courses (12 credits): Required for All Students in the Master's program

1. Math 561: Advanced Mathematics I (3 credits)
2. Math 562: Advanced mathematics II (3 credits)
3. CENG 550 / MSEG 625: Advanced Thermodynamics (3 credits)
4. CENG 565: Advanced Chemical Reaction Engineering (3 credits)

Elective Courses (12 credits): Determined by Student's Major Professor

The students will complete the remaining twelve (12) credits of course work (referred as electives) by taking graduate courses from the list given in section 7.

Transfer Credits
The student's Advisory Committee may recommend transfer credits for up to 9 hours for graduate courses taken by the student at Tuskegee University as part of another graduate program or at any other institution. Transfer credits may be recommended under both core and elective categories.

Advisory Committee
During the first semester of his/her study in the Master of Science program, the student and his/her Major Professor must recommend to the Head of the Department for approval, the student's Advisory Committee consisting of a minimum of four members including the Major Professor and the Head of the Department. The Advisory Committee shall also serve as the Examination Committee.

Admission to Candidacy
Immediately after completing 9 credits of course work at Tuskegee University, the student must submit, to the Dean of Graduate Studies, a completed application for the Candidacy for the degree.

Seminars
A student pursuing the Master of Science degree in Materials Science and Engineering must present at least two seminars. The first seminar shall be the presentation of the student's research proposal of the Master's thesis. The second or the final seminar shall be his/her Final Oral Examination for the degree. The student is also required to participate in all seminars arranged by the department.

Research assistantships and fellowships are available for students admitted to the program. Continuation of the financial support depends on student's performance in course work and research and availability of funds.

List Core Courses with University Catalog number and brief Description

CENG 510	**Chemical Engineering Analysis**, Lect. 3, Lab 0, Cr. 3. Prerequisite: Graduate Standing, Mathematical analysis of Chemical Engineering problems to include the formulation of differential equations, analytical and numerical techniques for problem solution, data correlation and analysis, computer applications.
CENG 520	**Advanced Heat Transfer**. Lect. 3, Lab 0, Cr. 3, Prerequisite CENG 310. Analysis and design principles for advanced heat transfer processes with special emphasis on two-phase heat transfer in reaction systems, packed beds, and other process equipment.
CENG 530	**Advanced Process Dynamics and Control**. Lect. 3, Lab 0, Cr. 3. Prerequisite CENG 430. Introduction to Modern Control Theory: Advanced linear control systems analysis and introduction to nonlinear systems. Topics includes design of nonlinear and robust controllers for various classes of nonlinear systems; model predictive control of linear and nonlinear systems, advanced methods for tuning of classical controllers, and introduction to control of distributed parameter systems.
CENG 540	**Advanced Chemical Engineering Transport Phenomena.** Lect 3, Lab 0, Cr. 3. Prerequisite CENG 410. Application of principles of momentum, energy, and mass transport to advanced problems in laminar and turbulent systems, including systems, with chemical reaction and interfacial phenomena.

CENG 550	**Advanced Chemical Engineering Thermodynamics** Lect. 3, Lab 0, Cr. 3. Prerequisite CENG 350, Application of the laws of thermodynamics to phase and chemical reaction equilibrium. Introduction to statistical thermodynamics, molecular simulations, and the evaluation of thermodynamic properties from molecular simulations.
CENG 565	**Advanced Chemical Reaction Engineering,** Lect. 3, Lab 0, Cr. 3, Prerequisite CENG 360. Emphasizes kinetics and mechanisms of heterogeneous reactions in different types of reactors. Specific topics include gas-solid noncatalytic reactions; catalytic surfaces and catalyst characterization; adsorption, diffusion, reaction, and heat transfer in porous catalysts.
CENG 570	**Advanced Water and Wastewater Treatment.** Lect. 3, Lab. 0, Cr. 3. Prerequisite: Graduate Standing. Physico-chemical hydrodynamics in water and wastewater treatment, Colloidal dispersions and electro-kinetic transport phenomena, Zeta potential, DLVO theory and particulate surface potential, water and wastewater filtration, Coagulation, flocculation, and disinfection, advanced oxidation methods, biological treatment systems.
CENG 575	**Environmental Solids Separation and Processing Methods.** Lect. 3, Lab 0, Cr. 3. Prerequisite: Graduate Standing. Application of physical processing methods to contaminated soils and solids treatment. Sampling, comminution and liberation. Classification and gravity separation, flotation methods, soil washing, bioozidation, bioleaching. Soil structure, classification and water content. Application of bioremediation methods for treatment of wastes from chemical and mineral industries.
CENG 580	**Separation Processes,** Lect 3, Lab 0, Cr. 3. Prerequisite: CENG 380, Design principles for multi-component, extractive, azeotropic, and other complex distillation processes. Design of gas absorption and extraction processes. Crystallization, membrane separation.
CENG 590	**Biochemical Engineering.** Lect. 3, Lab. 0, Cr. 3. Prerequisite: Graduate Standing. Basic microbiology, Enzyme kinetics, Michealis Menton kinetics, Complex kinetics expressions, Cell growth, Metabolic pathways, Engineering principles and application of cells, bioreactor scale-up and operation, Instrumentation and control, Mathematical modeling of bioprocesses, Bioprocess economics.
CENG 595	**Special Topics in Chemical Engineering.** Lect. 3, Lab 0, Cr 3. Prerequisite: Graduate Standing. Topics of interest to faculty and students such as: Computer-aided Process Design & Simulation, Irreversible Thermodynamics, Cryogenic Process Engineering and Electrochemical Engineering.
CENG 700	**Research Thesis.** Lect. 0, Lab. 0, Cr. 0 – 9. Arranged under supervision of a major professor in the specific area of research interest resulting in an approved typewritten dissertation. Prerequisite: Graduate standing
CENG 752	**Continuous Registration.** Lect. 0, Lab. 0. Cr. 0. Graduate students who have completed all the requirements except completing the dissertation, register in this course.
CENG 754	**Candidate for Degree.** Lect. 0, Lab. 0, Cr. 0. Graduate students who are planning to graduate in a given semester, register in this course.
MENG 551	**Advanced Heat Transfer.** Lect. 3, Lab. 0, Cr. 3. General problems of heat transfer by conduction, convection and radiation; solution by the analog and numerical methods, thermodynamic boundary layers, analysis of heat exchangers; problems on thermal radiation, extraterrestrial radiation.
MENG 512	**Advanced Fluid Mechanics.** Lect. 3, Lab. 0, Cr. 3. Development of rate of strain relationships for viscous compressible and incompressible fluid flow. General equations of motion, laminar and

	turbulent flow, boundary layer theory. Numerical methods in fluid mechanics.
MENG 634	**Numerical Analysis in Engineering.** Lect. 3, Lab. 0, Cr. 3. Theoretical and computational aspects of polynomial and spline approximations; numerical differentiation and integration; numerical solution of algebraic equations and of system of linear equations; Solutions of ordinary differential equations (initial value problems); analysis of iterative methods for non-linear, finite dimensional equations; Newton's method, gradient related methods, update methods, etc., finite difference approximations for elliptic and parabolic boundary value problems. The general thrust of this course is the application of these numerical methods in the design of engineering systems.
EVSC 501	**BIO-STATISTICS II.** Lect. 2, Lab 3, 3 credits. The application of advanced statistical methods in analyzing biological data to include analysis of two-way experiments, factorial experiments, covariance analysis, least-square analysis with unequal subclass numbers and curvilinear regression. Laboratory assignments require the use of the University's time share computer and departmental microcomputers. Prerequisites: EVSC 500 or Permission of instructor.
EVSC 504	**ENVIRONMENTAL SCIENCE II –** Lect. 3, 3 credits. Problems related to the presence of biologically active substances and potential hazardous synthetic chemicals in the environments. Strategies in minimization and management of these hazards will be discussed. Pesticides, radiation hazards, industrial chemical and potential biological hazards will be considered. Prerequisites: CHEM 320 or Permission of instructor
CHEM 0500	**INORGANIC SYNTHESIS.** Cr. 3. Synthesis and characterization of inorganic compounds. Vacuum, inert-atmosphere, electrolytic, spectroscopic and other techniques are utilized. Prerequisite: Chemistry 404, 308, and 323
CHEM 0513	**ADVANCED INORGANIC CHEMISTRY.** Cr. 3. Chemistry of elements other than carbon. Topics emphasize atomic and molecular structure, ionic and covalent bonding theories, symmetry, acid-base theories, transition metal compounds and chemistry of selected representative elements. Prerequisite: Chemistry 401
CHEM 0541	**INSTRUMENTAL ANALYSIS**. Cr. 4. The application of modern analytical techniques to analysis with emphasis on the instrumentation and the interpretation of experimental data. Prerequisites: Chemistry 307-8 & Chemistry 401
CHEM 0614	**SPECIAL TOPICS IN INORGANIC CHEMISTRY.** Cr. 3. Topics may be selected from the following: Transition metal chemistry, organometallic chemistry, kinetics and mechanisms, catalysis, crystallography, non-aqueous solvents; radio-chemistry, detailed chemistry of selected elements. Prerequisite: Chemistry 513
CHEM 0622	**ADVANCED ORGANIC CHEMISTRY.** Cr. 3. Fundamental principles and theories of organic chemistry at an advanced level. Prerequisite: Chemistry 321 & Chemistry 402
CHEM 0623	**SPECIAL TOPICS IN ORGANIC CHEMISTRY.** Cr. 3. Topics may be selected from the following: Stereochemistry, molecular orbital theory; free radicals; terpenes; heterocyclic compounds; photochemistry; new techniques in synthesis; and others. Prerequisites: Chemistry 321 & Chemistry 402
CHEM 0634	**CHEMICAL THERMODYNAMICS**. Cr. 3. Applications of the first and second laws to real gases, liquids and solutions and an advanced treatment of chemical equilibria. Prerequisite: Chemistry 402

MSEG 0601	**PHYSICS OF MATERIALS,** 3cr. To gain an understanding of the nature of materials based on the physical principles on which the properties of materials depend. The basic relationships introduced in undergraduate physics and chemistry courses are extended using the concepts of quantum mechanics to relate the properties of materials to their internal structure and external environment. Optical, electrical, thermal and magnetic properties of metals, semiconductors and insulators will be covered.
MSEG 0603	**POLYMER PHYSICS.** Cr. 3. Principles of polymer physics will be taught. Emphasis is placed on classification of polymers, molecular sizes, polymer blends, morphology, time-independent elasticity, linear viscoelasticity and yield, and yield and fracture of polymers.
MSEG 0604	**MATERIALS PROPERTIES AND CHARACTERIZATION,** 3cr, multidisciplinary course offering a practical hands-on experience with various analytical equipment and analysis of advanced composite materials including nanomaterials. Focus on sample preparation, principles and applications of various microscopy, thermal and mechanical methods. Covered topics include AFM, SEM, TEM, EDX, X-ray, TGA, DSC, DMA, TMA, tensile, compression and flexure tests.
MSEG 0605	**RESEARCH ETHICS.** Cr. 1. The course will provide students with an understanding of ethical issues in scientific research. Moral complexities in the engineering profession will be highlighted. Case studies will be used to illustrate how to analyze and resolve identified ethical issues.
MSEG 0606	**LITERATURE SEARCH AND TECHNICAL WRITING**. Cr. 2. To prepare the MSEG Ph.D. and MS candidates for writing professional papers, making presentations, and preparing theses. To accomplish this objective, the literature related to material science and engineering is surveyed. The tools for searching the material science and engineering literature are explored. The instructors critically analyze abstracts, formal papers and thesis-related writings prepared by the students.
MSEG 0612	**NANOSCALE SCIENCE AND ENGINEERING.** Cr. 3. This course aims to introduce students to nanoscale materials science and technology. It will cover topics such as nanoscale material synthesis, properties and applications. It will also emphasize the theory, modeling and simulation approaches used to understand the synthesis mechanisms and morphological changes in nanoscale materials systems, as well as the properties of materials at the nanoscale. The course will have a balanced materials science (main thrust of the course) mechanics, physics and chemistry and technology flavor. Prerequisites: graduate standing or senior undergraduate
MSEG 0621	**POLYMER SCIENCE AND ENGINEERING.** Cr. 3. Introduce the concepts of polymer science and engineering; Chain Structure and Configuration; Molecular weights and sizes, Concentrated Solutions and phase Separation Behavior; The Amorphous State; Viscoelasticity and Rubber Elasticity; Transistions and Relaxations; Crystalline State of Polymers; Morphology of Crystalline Polymers. (Prerequisite: MSEG 0603)
MSEG 0624	**POLYMER CHEMISTRY.** Cr. 4. A survey course on polymeric materials. Areas covered are the synthesis and reactions of polymers, thermodynamics and kinetics of polymerization, the physical characterization of polymers and the fabrication, testing and uses of polymers. These topics are integrated into both the lecture and the laboratory. Prerequisites: Organic Chemistry 321& 323; Physical Chemistry 402 & 404
MSEG 0643	**ELECTRONIC MATERIALS PROCESSING I.** Cr. 3. Theory and current technology for Si integrated circuit fabrication processes, including crystal growth, wafer preparation, epitaxy, oxidation, photolithography, diffusion, ion implantation, thin film deposition by chemical vapor deposition (CVD), etching and metallization, process simulation.
CENG 599	**Graduate Seminar.** Lec. 1, Lab. 0, Cr. 0. Prerequisite: Graduate Standing. Presentation of research projects by the graduate students and guest speakers

CENG 690	**Projects.** Cr. 3. An experimental study and analysis under minimum supervision of the major professor resulting in a typewritten report and an oral presentation.
CENG 700	**Research and Thesis.** Supervised research culminating in a written dissertation in conformity with requirements of the graduate handbook. Typically, two or more registrations of three hours each are required.
CENG 752	**Continuous Registration. See Graduate Handbook.**
CENG 754	**Candidate for Degree. See Graduate Handbook.**

List key **Graduate Faculty*** supporting the degree in the College

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Please go to http://www.tuskegee.edu/academics/colleges/ceps/chemical_engineering.aspx for further details