



**GRADUATE CERTIFICATE IN COMPOSITES
MANUFACTURING AND ENGINEERING**

ACADEMIC PROGRAM APPLICATION

FALL 2017

Provide a brief summary of the proposed program changes and describe the rationale for the change(s):

The Online Graduate Certificate in Composites Manufacturing and Engineering will (1) train students with a background in composites manufacturing needed for strategic manufacturing research initiatives in the college, (2) provide professional development training to staff and students in e-learning to help faculty transform their existing course offerings into appropriate interactive online modules, (3) encourage faculty to put their existing courses online by providing a course model and online infrastructure, (4) stimulate the development of new course offerings that can be included in future manufacturing degree programs and to supplement the certificate offerings, and (5) complement and enhance UD's existing course offerings in composite materials.

This initiative is closely aligned with the College of Engineering's strategic manufacturing research and education initiatives. Advanced manufacturing is a major national initiative and is reflected in the National Network for Manufacturing Innovation (NNMI) and the current bi-partisan initiative aimed at establishing "Manufacturing Universities" spearheaded by Senator Coons that was recently included as part of the 2017 National Defense Authorization act¹. This new Graduate Certificate is being initiated and supported by the College of Engineering's Manufacturing Committee which is charged to formulate a program/curriculum in Manufacturing in response to the Manufacturing Universities initiative. These courses are also intended to form the foundation for a university-wide curriculum on additive manufacturing through a UD institute established by Unidel funds.

List new courses required for the new curriculum. How do they support the overall program objectives of the major/minor/concentrations?

MEEG656 Practice Composites Manufacturing

MEEG657 Experimental Characterization of Composites for Manufacturing

These two courses will simulate a lecture-laboratory environment online. Our "virtual laboratory" approach will train both the professional composites manufacturing workforce as well as on-campus students in practical and fundamental aspects of manufacturing and characterization. These entirely new module-based courses, designed based on input and feedback from industrial partners, will include detailed videos combined with interactive lecture materials. Videos will simulate hands-on manufacturing, highlighting the technical as well as practical aspects of different composites manufacturing processes. For materials characterization modular lectures will couple fundamental techniques commonly used to characterize composite properties with detailed videos of sample preparation and approaches for data analysis. The course will make extensive use of CCM's state-of-the-art chemical, thermal, and mechanical characterization laboratories. Students will be given data sets from characterization of real composites manufactured in the CCM laboratories to analyze and understand influence of processing on composite properties.

Identify other units affected by the proposed changes and provide letters of support from those units:

No other units will be affected by this new program.

Resolutions

WHEREAS, the Department of Mechanical Engineering (ME) and the Center for Composite Materials (CCM) is internationally known for research and education in composite materials. CCM has over 2,000 alumni in the composites engineering workforce worldwide, and the department has offered signature courses in composite materials for over four decades,

WHEREAS, with composite materials increasingly used in many applications there is a critical need to educate the engineering workforce on how to design and manufacture composite materials, and

WHEREAS, industries utilizing composite materials -- which spans aerospace, automotive, wind energy, and infrastructure -- have difficulty finding adequate personnel to fill current employment positions, and

WHEREAS, ME and CCM frequently receive inquiries over the past several years from individuals interested in completing graduate studies with an emphasis on composite materials, and

WHEREAS, the Graduate Certificate in Composites Manufacturing and Engineering will provide professional education and training at the graduate level focusing on the manufacturing and characterization of advanced composite materials with an emphasis on understanding the processing-structure-property relations, and

RESOLVED, that the Faculty Senate recommends the approval of the establishment of a new Graduate Certificate in Composites Manufacturing and Engineering.

I. PROGRAM HISTORY

RATIONALE

There is a major industry-wide emphasis on composites manufacturing. In composite materials, there is a critical link between their processing and performance, and design rules for composite materials are fundamentally different than traditional materials. The engineer tailors the material structure at the micro- and nano-scales to achieve the desired mechanical and physical properties; this micro-scale structure is formed during the manufacturing process. Our certificate program is closely aligned with the College of Engineering's strategic manufacturing research and education initiatives. The new online certificate program will extend the reach of the department's signature education and research programs in composite materials and the focus on manufacturing aligns the college with the national emphasis on manufacturing.

DEGREE OFFERED

The program will offer the Graduate Certificate in Composites Manufacturing and engineering.

II. ADMISSION

ADMISSION REQUIREMENTS

Admission to the graduate certificate program is competitive. Those who meet stated requirements are not guaranteed admission, nor are those who fail to meet all of the requirements necessarily precluded from admission if they offer other appropriate strengths.

The following are the admission requirements to the Composite Manufacturing and Engineering Graduate Certificate:

- Applicants must hold a bachelor's degree from an accredited four-year college or university with a minimum grade point average of 3.0 on a 4.0 system. Significant relevant work experience or a graduate degree in a relevant technical discipline may be considered in lieu of meeting the GPA guideline.
- Applicants must have an undergraduate degree in engineering or related discipline. Applicants with degrees in other disciplines may be admitted depending on their experience in relevant disciplines. Applicants are expected to have scholarly competence in engineering mathematics, solid mechanics, fluid mechanics, and heat transfer.
- International applicants must demonstrate a satisfactory level of proficiency in the English language if English is not their first language. The University requires an official TOEFL score of at least 550 on paper-based or at least 79 on the Internet-based test.
- GREs are not required.
- Applications must also include a resume outlining work and academic experience.

Applications to the Graduate Certificate in Composites Manufacturing and Engineering must be submitted using the online graduate admission application. If any part of the application is missing, evaluation of the application cannot begin.

Admission decisions are made on a rolling basis and when applications are completed. Applications are accepted up to the first day of classes for a given semester.

III. ACADEMIC

PROGRAM REQUIREMENTS

The Graduate Certificate in Composites Manufacturing and Engineering requires 9 credits chosen from the courses outlined below. Each certificate program course must be completed with a grade no lower than a B- and students must obtain at least a 3.0 cumulative grade point average in the program curriculum to receive the Graduate Certificate.

Certificate in Composites Manufacturing and Engineering (9 credits chosen from the following)	
MEEG 617 – Composite Materials	Fiber and matrix materials, fiber-matrix interface, polymer, metal, ceramic and carbon matrix composites, geometric aspects, elastic properties, lamination theory, strength of unidirectional composites, strength of laminates, durability, hybrid composites, flexible composites and textile structural composites.
MEEG 655 – Principles of Composites Manufacturing	Fundamental principles involved in composites manufacturing are introduced. Modeling of such processes emphasized with applications of injection molding, compression molding, filament winding, pultrusion and resin transfer molding.
MEEG 656 Practical Composites Manufacturing	Explains key concepts and elements of composites manufacturing processes, technologies and systems. An online-only course where lectures are coupled with detailed videos of manufacturing processes and exercises with simulation software to connect theory to practice.
MEEG 657 Experimental Characterization of Composites for Manufacturing	Explains theory and practice for composite materials characterization techniques (mechanical, thermal, microscopic and spectroscopic) with an emphasis on understanding the processing-structure-property relations and understanding the influence of processing on composite quality.

SATISFACTORY PROGRESS

Students in the Composites Manufacturing and Engineering Certificate must select three courses from a total of four graduate level courses. Two courses will be offered each semester so that the certificate program can be completed in as little as one year.



College of Engineering

DEPARTMENT OF MECHANICAL
ENGINEERING

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November 21, 2017

Dear Faculty Senate Members,

The Department of Mechanical Engineering fully supports the proposed Graduate Certificate in Composites Manufacturing. This new online certificate program is being developed with support provided by the Provost's E-Learning initiative. It will extend the reach of the department's signature education and research programs in composite materials and the manufacturing focus helps to align the department with the national emphasis on manufacturing.

The certificate can be earned by completing three courses selected from the following:

MEEG 617 Composite Materials
MEEG 655 Principles of Composites Manufacturing
MEEG 656 Practical Composites Manufacturing
MEEG 657 Experimental Characterization of Composites for Manufacturing

Please feel free to contact me if I can provide additional information or assistance.

Sincerely,

A handwritten signature in black ink, appearing to read 'Ajay K. Prasad', followed by a horizontal line extending to the right.

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