TEXAS A&M UNIVERSITY KINGSVILLE

NIST National Institute of Standards and Technology U.S. Department of Commerce

Curricular Integration of Design and Material Standards in Engineering (CID-MaSE)

Award No. 70NANB21H175

Period of Performance: 09/15/2021 - 09/14/2023

Project Team

Mohammad M. Hossain, Ph.D.
Associate Professor, Department of Mechanical & Industrial Engineering

Larry D. Peel, Ph.D., P.E.
Professor, Department of Mechanical & Industrial Engineering

Breanna M. Bailey, Ph.D., P.E.
Professor and Interim Chair, Department of Civil & Architectural Engineering

Project Objectives

Goal: Stimulate students' interest in standards and standardization methods in a way that will increase their use of standards throughout their professional career.

Focus: Standards related to engineering design, and material testing and characterization.

Specific Objectives:

- Educate engineering students about design- and materials-related standards, the standardization procedures and standards-related organizations.
- Through repeated classroom practice, embed a deep appreciation and understanding of standards in students.
- Through reinforcement in multiple courses and a certificate program, instill the importance of standards and standardization into students in a way that will promote life-long use of standards in their professional careers.

Project Plan

Level	Mechanical Engineering	Civil and Architectural Engineering
Freshman	**GEEN 1201**: Engineering as a Career.	**GEEN 1201**: Engineering as a Career.

- Develop general awareness towards standards and their importance
- Learn different types of standards and standardization organizations
- Identify the key processes that are involved in a standardization procedure

Project Plan (Cont'd)

Level	Mechanical Engineering	Civil and Architectural Engineering
Sophomore	**MEEN 3145: Material Science Laboratory** ▪ Add ASTM standard-based experiments ▪ Modify course modules to improve students' critical thinking and appreciation of standards ▪ Update Exams **MEEN 3344: Materials Science** ▪ Focus on understanding standard material characterization processes ▪ Update term paper component more towards standards and standardization **CEEN 3311: Strength of Materials** ▪ Incorporate material specifications and testing procedures into class discussions ▪ Introduction of relevant design codes (AISC, ACI, and ASME boiler code)	**CEEN 3311: Strength of Materials** ▪ Incorporate material specifications and testing procedures into class discussions ▪ Introduction of relevant design codes (AISC, ACI, and ASME boiler code)

Project Plan (Cont'd)

Level	Mechanical Engineering	Civil and Architectural Engineering
Junior	**MEEN 3349: Fundamentals of Manufacturing Processes** ▪ Understanding of standards for materials and manufacturing, and how standards ensure high quality products and processes ▪ A new module to discuss standard materials, fabrication processes, and testing for additive manufacturing ▪ Add ASTM standard-based experiments	**CEEN/AEEN 3303: Structural Analysis** ▪ Add module on dead, live, and wind load calculations using ASCE 7 that will be summarized in a course project **CEEN/AEEN 3304: Reinforced Concrete Design** ▪ Highlight the importance of using standards and codes in the design process **CEEN 3145: Construction Materials Lab** ▪ Similar to MEEN 3145 **CEEN 3244: Construction Materials** ▪ Similar to MEEM 3344

Project Plan (Cont'd)

Level	Mechanical Engineering	Civil and Architectural Engineering
Senior	**MEEN 4382: Polymer Science & Engineering** ▪ Similar to MEEM 3344, but focus on polymeric materials **MEEN 4385: Manufacturing of Composites** ▪ Understanding and using standards in specifications, manufacturing and material testing for polymer composites and adhesives ▪ Identification of standards and standardization procedures that are specific to polymer composites fabrication, including 3D printing of composite structures ▪ Add ASTM standard-based experiments **Senior Design Project** ▪ Provide guest lectures ▪ Include standards and standardization techniques in design reports	**CEEN/AEEN 4316: Structural Steel Design** ▪ Add a module to discuss the structure of AISC and the processes used to revise the steel manual **Senior Design Project** ▪ Provide guest lectures ▪ Include standards and standardization techniques in design reports

Project Plan (Cont'd)

Level	Mechanical Engineering	Civil and Architectural Engineering
Graduate	**MEEN 5303: Advanced Manufacturing of Composites** ▪ Elevated versions of MEEN 4385 modifications **MEEN 5331: Advanced Materials Science** ▪ Update term paper component more towards standards and standardization ▪ Add modules that discuss significance of standards in material testing and characterization, advanced material testing standards, standards development processes, etc. **MEEN 5333: Polymer Science** ▪ Similar to MEEN 5331, but focus on polymeric materials	**CEEN 5361: Advanced Structural Steel Design** ▪ Include discussion of ACI codes relevant to the design of composite beams and columns

Project Plan (Cont'd)

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Transcripted Certificate on Standards for Material Testing, Characterization and Applications

Undergraduate:

- Attend 6 one-hour seminars, offered through the certificate program
- Complete 12 credits from a list of courses with a grade of "B" or better in each
- Senior Design Project that has significant components on standards

Graduate:

- Attend 6 one-hour seminars, offered through the certificate program
- Complete 9 credits (3 courses) from a list of courses with a grade of "B" or better in each
- MS Thesis that has significant components on standards

Timeline

Date (Semester)	Course(s)	Activity
Sept. 2021-Dec. 2021 (Fall 2021)		• Development of modules to be implemented in MEEN 3145, CEEN/AEEN 3303, CEEN 3311, MEEN 3344, MEEN 3349, MEEN 4385, MEEN 5303-AMC, and CEEN 5361 courses. • Selection and development of modules in 3 additional courses (CEEN 3145, CEEN 3244, and CEEN/AEEN 3304) to be implemented in Spring 2022, and selection of 1 additional course (GEEN 1201) to be implemented in Fall 2022, where the PIs are not directly involved. • Organize the certificate program to be offered in Spring 2022.
Jan. 2022-May 2022 (Spring 2022)	MEEN 3145, MEEN 3344, and MEEN 3349 (*Group 1*); CEEN 3145, CEEN 3244, CEEN/AEEN 3303, CEEN/AEEN 3304, CEEN 3311, MEEN 4385, MEEN 5303-AMC, and CEEN 5361 (*Group 2*)	• First implementation of the developed modules into Groups 1 and 2 courses. • Evaluation activities of Groups 1 and 2 courses, as described. • Development of modules to be implemented in GEEN 1201 course. • Six 1-hour seminars. Certificate program.
June 2022-Aug. 2022 (Summer 2022)		• Development of modules to be implemented in CEEN/AEEN 4316, MEEN 4264, IEEN 4264, CEEN 4289, AEEN 4289, MEEN 4382, MEEN 5303-PS, and MEEN 5331 courses. • Improvement of modules of Groups 1 and 2 courses based on the evaluation.
Sept. 2022-Dec. 2022 (Fall 2022)	GEEN 1201, CEEN/AEEN 4316, MEEN 4382, MEEN 5303-PS, and MEEN 5331 (*Group 3*)	• First implementation of the developed modules into Group 3 courses. • Evaluation activities of Group 3 courses, as described.
	Group 1 courses	• Implementation of the improved modules into Group 1 courses. • Evaluation activities of Group 1 courses, as described.
Jan. 2023-May 2023 (Spring 2023)	Group 2 courses	• Implementation of the improved modules into Group 2 courses. • Evaluation activities of Group 2 courses, as described. • Six 1-hour seminars. Certificate program.
	MEEN 4264, IEEN 4264, CEEN 4289, and AEEN 4289 (*Group 4*)	• First implementation of the developed modules into Group 4 courses. • Evaluation activities of Group 4 courses, as described.
June 2023-Sept. 2023 (Summer 2023)		• Improvement of modules of Groups 3 and 4 courses based on the evaluation. • Evaluation and improvement of certificate program.
	For all courses	• Summarize the findings and write Final Summary Paper.

Communication Plan

- Project Website at TAMUK
  - All standards-related modules, revised course syllabi, and related publications will be posted and updated on this website
- Emails with Project Website links will be sent to the ASME, AIAA, SME, SPE, and other department chair listservs
- Project findings, experiences and lessons learned will be presented at national and international technical conferences
- Visit universities in the South Texas region, such as the University of Texas-Rio Grande Valley, Texas A&M International University, and Texas A&M University-Corpus Christi to share the experiences and education model
- Final Summary Paper

Impact and Update

- At least 200 undergraduate and graduate students in Engineering are expected to be inspired through this project every year, including Mechanical Engineering, Civil Engineering, and Architectural Engineering as well as other engineering majors
- Undergraduate Certificate Program has been approved by the department and college curriculum committees, and currently under review in the university curriculum committee
- Graduate Certificate Program has been approved by the department curriculum committee, and is currently under review in the college curriculum committee
- Working on course modules development

Thank You!