Michigan Tech

Office Memo

Office of the Provost and
Senior Vice President for Academic Affairs

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TO: Richard Koubek, President

FROM: Jacqueline E. Huntoon, Provost & Senior Vice President for Academic Affairs

Jacqueline E Huntoon

DATE: November 18, 2020

SUBJECT: Senate Proposal 4-21

Attached is Senate proposal 4-21, “Establishment of a New Graduate Certificate in Quality Engineering,” and a memo stating the Senate passed this proposal at their November 11, 2020 meeting. I have reviewed this memo and recommend approving this proposal.

I concur X do not concur_____ with this recommendation.

Richard Koubek, President

11/19/20

Date

Michigan Tech

University Senate

DATE:	November 12, 2020
TO:	Richard Koubek, President
FROM:	Sam Sweitz University Senate President
SUBJECT:	Proposal 4-21
COPIES:	Jacqueline E. Huntoon, Provost & Senior VP for Academic Affairs

At its meeting on November 11, 2020, the University Senate approved Proposal 4-21, "Establishment of a New Graduate Certificate in Quality Engineering". Feel free to contact me if you have any questions.

The University Senate of Michigan Technological University
Proposal 4-21

Establishment of a New Graduate Certificate in Quality Engineering

Submitted by:
Department of Mechanical Engineering – Engineering Mechanics

1. **Proposal Date:** May 22, 2020

2. **Proposing Contacts and Departments:** Radheshyam Tewari, Sr. Lecturer, ME-EM, rtewari@mtu.edu;

3. **Sponsor Department Approvals:** May 26, 2020

4. **General Description and Characteristics**

4.1. General Description: The Graduate Certificate in Quality Engineering prepares students for careers in the field of Quality Engineering. Students complete two (2) required and one (1) elective courses for a total of nine (9) credits to earn the certificate. The required and elective courses facilitate students with mastering the process of statistical process control (SPC), statistical methods using R/RStudio and SAS Studio software for statistical computing and preparation of statistical reports, principles and techniques of design of experiments, and concepts of lean manufacturing as tools and techniques for solving real-world product, process, and productivity-related problems in the quality engineering field. Upon successful completion of the certificate, students will be able to:

a. Apply SPC to improve manufacturing and non-manufacturing processes.
b. Identify and implement appropriate statistical methods to experimental designs.
c. Communicate results and inferences of a statistical procedure in a technical report.
d. Apply lean concepts to eliminate waste and improve a process.

4.2. Catalog Description: The certificate provides the conceptual and mathematical foundations of the tools and techniques used in the field of Quality Engineering. Topics include control charts, process capability analysis, design of experiments, descriptive and graphical data summaries, hypothesis testing, regression analysis, and concepts of lean manufacturing.

5. **Rationale for the Certificate**

Productivity and process and product quality have always been among the most critical measures that effect the profit and success of all businesses. The Graduate Certificate in Quality Engineering will help students find careers in a variety of manufacturing and non-manufacturing sectors. This certificate will serve certificate-seeking students who wish to develop the conceptual and mathematical skills as part of their professional development. The certificate-seeking students can enhance their skills as well as use the certificate as a foundation to continue towards a graduate degree. The mathematical skills that this certificate program is built upon are relevant for STEM fields and can serve as a foundation or starting point to a multitude of degree

programs. The certificate will also serve degree-seeking students who wish to develop a concentration that gives them an edge in their career search in a variety of industries.

6. Related Programs

Several comparable certificates can be pursued in or outside the state with a few examples shown below.

1. **Eastern Michigan University** - Advanced Graduate Certificate in Quality Management. Requires a total of eighteen (18) credit hours. Fifteen (15) credit hours must come from five required core courses. The remaining three (3) credit hours can be from one of the several possible elective course with quality specialization.

2. **University of Wisconsin-Madison** - Certificates in Lean Six Sigma Yellow Belt, Green Belt, and Black Belt. The Yellow Belt requires one (1) required course over 3 days in a face-to-face format with 2.1 continuing education units (CEUs) requirement. The Green Belt requires three (3) core courses, one (1) elective course, and an independent project over 11–13 days in a face-to-face format with no credit hour requirements. The Black Belt requires four (4) core courses from eight (8) possible core courses over 11–12 days in mostly face-to-face format with no credit hour requirements. One of the eight core courses is offered as a self-paced online course.

3. **University of Central Florida** - Graduate Certificate in Quality Assurance. Requires a total of twelve (12) credits. Nine (9) credits must come from three (3) required courses on statistics, reliability, and quality design and control. The remaining three (3) credits can come from one of the two elective courses with emphasis on TQM and QM.

4. **Washington State University** - Graduate Certificate in Six Sigma Quality Management. Requires a total of twelve (12) credit hours. Students must complete three (3) required courses (9 credit hours) and one of the two (2) elective courses (3 credit hours). Required and elective courses include Quality Control and Reliability, Design of Experiments, Systems Improvement Integrating TOC, Lean, and Six Sigma, Lean Tools for Systems Improvement, and Leading Design and Innovation.

5. **University of Arizona** - Graduate Certificate in Quality & Reliability Engineering. Requires a total of twelve (12) units of coursework. Nine (9) units must come from the three (3) required courses on quality, reliability, and statistics. The remaining three (3) units must come from one of several possible elective courses, which include Simulation Modeling & Analysis, Engineering Decision Making under Uncertainty, Supply Chain Management, Experiment Design and Regression, and Advanced Quality Engineering.

7. Projected Enrollments

Table 1 shows estimated minimum enrollments assuming the certificate is advertised. The enrollment cap will depend on the number of sections that can be allocated to each course.

Table 1. Estimated minimum enrollment by year.

Academic Year	Estimated Minimum Enrollment	
	On-Campus	On-Line
2020-21	5	5
2021-22	5-10	5-10
2022-23	5-10	5-10
2023-24	5-10	10-15
2024-25	5-10	10-15

8. Scheduling Plans

Class schedules of already offered on-campus and online required and elective courses will not require changes. The semester schedule for the online version of the elective course MEEM 5670 will need to be decided as it is currently only offered as an on-campus course.

9. Curriculum

This 9-credit certificate consists of two 3-credit required courses and one 3-credit elective. The required and elective course list with the course descriptions are given below. It is expected that students will work with the program advisor to select courses that fit their interests and prerequisite skills. Marketing and advising will be used to differentiate the curriculum path for on-campus and online students.

Required Courses - 6 credits

1. **MA 5701: Statistical Methods** (3 Credits). MA 5701 is offered on-campus in fall and online in fall, spring, and summer. The fall and spring online offering are for off-campus students only. The summer online offering is open to everyone.

2. **MEEM 5650: Advance Quality Engineering** (3 Credits). MEEM 5650 is offered on-campus in fall and online in spring and summer. The spring online offering is for off-campus students only. The summer offering is open to everyone.

Elective Courses - 3 credits (select 1)

1. **MEEM 5655: Lean Manufacturing** (3 Credits). MEEM 5655 is offered on-campus in spring and online in fall. The fall online offering is only for off-campus students.

2. **MEEM 5670: Experimental Design in Engineering** (3 Credits). MEEM 5670 is currently only offered on-campus in fall.

10. Course Descriptions

MA 5701: Statistical Methods – 3 credits

This course introduces the design and analysis of statistical studies, with an emphasis on statistical computing and preparation of statistical reports. Topics include the design of

experiments, descriptive and graphical data summaries, and the analysis of data with classical parametric and nonparametric hypothesis testing, including the one-way analysis of variance, simple linear regression, and Pearson's chi-squared tests on contingency tables.

MEEM 5650: Advanced Quality Engineering – 3 credits
Introduction to the concepts and methods of quality and productivity improvement. Topics include principles of Shewhart, Deming, Taguchi; meaning of quality; control charts for variables, individuals, and attributes; process capability analysis; variation of assemblies; Monte Carlo simulation, multi-variate situations; and computer-based workshops.

MEEM 5655: Lean Manufacturing – 3 credits
Lean manufacturing is emerging globally as a paradigm by which business units must function to be globally competitive. Quality, cost, and delivery have become critical measures that impact profits and, in turn, the success of an organization. Significant improvements in all these three measures come from the continuous elimination of waste, or non-value-added activities, in manufacturing. Numerous tools are available for the elimination of waste and making businesses lean. This course is intended to familiarize students with this new philosophy of lean manufacturing and arm them with a basic toolset that enables the identification, measurement, and elimination of non-value-added activities.

MEEM 5670: Experimental Design in Engineering – 3 credits
Review of basic statistical concepts. Models for testing significance of one or many factors. Reducing experimental effort by incomplete blocks, and Latin squares. Factorial and fractional factorial designs. Response surface analysis for optimal response.

11. Model Schedule Demonstrating Completion Time

The minimum completion time for on-campus students is one (1) semester if MEEM 5670 is selected as the elective course. The minimum completion time for online students is two (2) semesters. Typical schedules with minimum completion time for on-campus and online students are shown below.

On-campus (one semester model schedule)
Fall Semester
MA 5701 (required)
MEEM 5650 (required)
MEEM 5670 (elective)

Online (two semester model schedule)

Fall Semester	**Spring Semester**
MA 5701 (required)	MEEM 5650 (required)
MEEM 5655 (elective)	

12. Library and Other Learning Resources

No new resources from the library are required. Students may need to purchase prescribed textbooks for the required and elective courses. Students may need access to statistical and computational software Excel, Minitab, Matlab, R/RStudio, and SAS Studio to successfully

complete courses. Students can download and install the required software from the Michigan Tech Software Distribution Center. Students can also register with SAS to freely access SAS Studio on internet. Students can also access some of the required software by Remote Access to Michigan Tech Computer Labs.

13. Faculty Resumes

The current associated faculty and the certificate courses they have taught are given below. Faculty names are hyperlinked to their Michigan Tech faculty profile webpages. The listed faculty are certified to deliver online courses.

Ray Molzon, Lecturer, Mathematical Sciences (MA 5701)
Dana Johnson, Professor Emerita and Affiliated Professor, ME-EM (MEEM 5650, 5655)
Radheshyam Tewari, Sr. Lecturer, ME-EM (MEEM 5650, 5655, 5670)

14. Equipment

None

15. Program Costs

There are no new costs to offer the certificate to on-campus students. Costs will be incurred for the on-line certificate to (1) develop initial online version of the MEEM 5670 elective course and (2) adjust online content for new software versions and examples. These costs can be met assuming the tuition return to departments are not decreased.

16. Space

None

17. Policies, Regulations, and Rules

None

18. Accreditation Requirements

Michigan Tech is accredited by the Higher Learning Commission (HLC). The proposed certificate will not require additional accreditation. The proposed certificate will meet HLC criteria 3 and 4.

19. Implementation Date

Spring 2021

20. Assessment

The Graduate Student Learning Objectives (GLO) of the Certificate are:
1. Apply statistical process control for continuous improvement.
2. Apply quality engineering tools for process and product quality and productivity improvement.
3. Analyze data and display professional communication skills (written and oral) of engineers working in the quality engineering field.

Department approval: May 26, 2020
College of Engineering approval: May 28, 2020