MENG515 – MULTIDISCIPLINARY DESIGN OPTIMIZATION

Department:
Mechanical Engineering

Program Name: Mechanical Engineering	**Program Code:** 23	
Course Number: MENG515	**Credits:** 3 (3,0)	**Year/Semester:** 2018-2019 Fall

☐ Required Course ☒ Elective Course ☐ Service Course

Prerequisite(s):
N/A

Catalog Description:
Multidisciplinary Design Optimization (MDO) deals with the optimization of several engineering disciplines simultaneously. It provides the opportunity to find the optimal solution of a system accounting for the interactions between the different disciplines. It has application potential in all fields of engineering especially, Mechanical, Mechatronics, Energy, Electrical, Electronics, Aerospace, Manufacturing and Industrial Engineering.

The topics covered include: Introduction to Optimization, Design Architectures, Unconstrained & Constrained Optimization, KKT Conditions, Genetic Algorithm, Particle Swarm Optimization, Simulated Annealing, Multi-Objective & Hybrid Optimization, Design of Experiments, Robust Design, Meta-Modeling, FMEA, VMEA, Post Optimality Analysis.

Course Web Page:
https://staff.emu.edu.tr/qasimzeeshan/en/teaching/meng-515

Textbook(s):
Course notes/presentations are availableon the website

Indicative Basic Reading List :
Engineering Optimization Theory and Practice by Singiresu S. Rao, JOHN WILEY & SONS, INC., 2009

Topics Covered and Class Schedule:
(3 hours of lectures per week)

Week 1	Multidisciplinary Design Optimization
Weeks 2-3	Classical Optimization Methods
Weeks 4-5	Modern Heuristic Optimization Methods
Week 6	Structural Optimization
Week 7	Aerodynamic Shape Optimization
Weeks 8-9	**Mid-Term Examination**
Week 10	Multidisciplinary Design Optimization Architectures
Week 11	Multidisciplinary Design Aspects Of Complex Systems
Week 12	Multi-Objective, Hybrid & Hyper-Heuristic Optimization
Week 13	Robust Design
Week 14	Post Optimality Analysis
Week 15:	**Final Examination & Project Presentation**

Term Assignment:
Each student is expected to choose a term project and produce a paper at the end of the semester. Students are also required to make presentations during the semester. Completion of the term assignment is a requirement to pass the course.

Course Learning Outcomes: Upon successful completion of the course, the student will demonstrate competency by being able to:

1. Learn how MDO can support the product design process of complex, multidisciplinary engineering systems
2. Learn how to rationalize and quantify a system architecture or product design problem by selecting appropriate objective functions, design parameters and constraints
3. Subdivide a complex system into smaller disciplinary models, manage their interfaces and reintegrate them into an overall system model
4. Gain an understanding of the principles and developments in Optimization
5. Learn practical methods for solving Optimization problems
6. Learn to implement Optimization Algorithms to practical design problems
7. Perform a critical evaluation and interpretation of analysis and optimization results, including sensitivity analysis and exploration of performance and cost.
8. Be familiar with the basic concepts of multi-objective optimization, including the conditions for optimality and Pareto front computation techniques
9. Practice oral and written communication skills in a team environment.

	Method	**No**	**Percentage**
Assessment	Midterm Exam(s)	1	20 %
	Assignment	1	20 %
	Design Project report and Presentation **	1	20 %
	Final Examination	1	40 %

Contribution of Course to Criterion 5
Credit Hours for:
Mathematics & Basic Science : 0
Engineering Sciences and Design : 3
General Education : 0

Relationship of Course to Program Outcomes
The course has been designed to contribute to the following program outcomes:

a. an ability to apply knowledge of mathematics, science, and engineering.
c. design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
d. an ability to function on multi-disciplinary teams
e. an ability to identify, formulate, and solve engineering problems.
f. an understanding of professional and ethical responsibility.
g. an ability to communicate effectively.
i. a recognition of the need for, and an ability to engage in life-long learning.
k. use the techniques, skills, and modern engineering drawing and Design tools necessary for engineering practice

Prepared by: Associate Prof. Dr. Qasim Zeeshan	**Date Prepared:** September 2019

Important Notes:

University rules and regulations are applied to this course. **For details, please see** http://mevzuat.emu.edu.tr

* Submission of the project report on the designated topic in the format of a paper.
** Short presention on the selected topic (30 mins)
Late Submissions of the Assignments and Project will be graded as zero.
There is no **make-up or resit** for the **Mid term or Final.**
NG Policy: Students who do not attend any of the above assessment activities (such as mid-term exam, project report, presentation etc.) will be given **NG (Nil Grade).**