T-865-MADE **PRECISION MACHINE DESIGN** **8 ECTS**

Year of study:	First year MSc.
Semester:	Fall.
Level of course:	5. Second cycle, intermediate.
Type of course:	Core for MSc Mechanical Engineering, elective for other programs.
Prerequisites:	1) Basic PLC, Python, C/C++ or Java programming; 2) Basic electronics (resistors, inductors, capacitors); 3) Understanding of structural analysis (stresses, strains, bending); 4) Familiarity with solid modeling tool (Inventor, Solidworks, etc).
Schedule:	Runs for 12 weeks – 6 teaching hours a week.
Supervisor:	Joseph Timothy Foley.
Lecturer:	Joseph Timothy Foley.

Learning outcome: On completion of the course the student should be able to:

- solve complex and open-ended "hard" mechanical design problems using systematic design processes.
- Apply Axiomatic Design to develop Functional Requirements, Design Parameters, and Design matricies
- analyze error budgets in machine design and propose improvements
- understand what is "hard" about precision and how to address those challenges
- create effective design documents including reports, risk assessment, and time assessment
- present their ideas effectively for customers and peer reviews
- design and perform experiments to test design choices
- build prototypes of their designs
- analyze the performance of prototypes through experiments
- harness creative instincts as part of a deterministic process
- competently use CAD modeling(Creo, Solidworks, Inventor), LaTeX, Subversion

Content: A systematic approach to designing machines able to perform a task reliably and repeatedly. Factors that are of minor importance for low-performance simple machines can quickly become impossible obstacles without the right tools and techniques. The tools introduced in this class is Axiomatic Design Theory aka. Complexity Theory. In this class these techniques will be applied for designing and building high-perfomance machine(s) with our sponsors. Customers will be interviewed to develop Customer Needs(CN). From these CNs, Functional Requirements and Design Parameters will be developed to evaluate possible solutions. The chosen solution will be prototyped and evaluated. LaTeXintroduced for proper documentation and citation generation with Subversion as a mechanism for collaboration. There is a high expectation of documentation and mathematical analysis.

Reading material: *Complexity: Theory and Applications,* By Nam P. Suh. Oxford University Press. 2005

Teaching and learning activities: Design is a heavily interactive communication process and this will be reflected in the teaching of this class. Students will be given interactive lectures on material then are expected to apply this material to practical problem sets and hands-on labs. During lectures, students will be asked to solve design problems on the board with the help of other students and the lecturer. Students will also be presenting their ideas in design reviews to get proper feedback and develop collaboration skills. Students will be applying these real-world skills on a term project with an outside sponsor to develop a high-end precision machine. We will be using some existing equipment to demonstrate such concepts and building others as part of the course. Expect to get your hands dirty disassembling machinery, programming robotic machines, and building new machinery.

Assessment methods: Student capability will be primarily assessed based upon quality of work and presentation of projects. No final exam, instead a final project presentation, report, and video or poster. Students must be able to effectively communicate their ideas through written and oral methods. Students will each have a research notebook which must be used on a regular basis and will be checked periodically for grading purposes.

Due to the high participation required to execute successful teamwork on a final project, there is a 66% attendance requirement. If you have lower than this attendance, you will not pass the course regardless of your other grades.

The final project will be evaluated on these three aspects:

- process
- documentation
- product/result

Proper citation is a requirement in this class, without exemptions. This is most relevant for reports and presentations. All material from an outside source (ideas, text, pictures) must include a proper citation. IEEE is the preferred citation format. Failure to include citations will result in a 0 for the assignment and considered plagiarism. You are explicitly given permission to use the RU logo on your reports and presentations without citation because you are enrolled at our university.

Late work will be penalized according to the degree of lateness. The penalty is 1 point per day late, to a maximum penalty of 5 points. Late work will only be accepted up to 2 weeks late or until the end of finals, whichever is shorter.

Language of instruction: English.

All course descriptions may be subject to change. Revised information on the course schedule, reading material, teaching and learning activities, and assessment methods will be introduced in the learning management system Canvas at the beginning of the semester.