Course Title	Mechanical Engineering Design and Optimisation				
Course Code	ME414				
Course Type	Compulsory				
Level	BSc (Level 1)				
Year / Semester	4th Year / 8th Semester				
Teacher's Name	Dr.-Ing. Loucas Papadakis				
ECTS	6	Lectures / week	3	Laboratories/week	-
Course Purpose	Mechanical engineering design methods possess a key position in modern production industries. Moreover, numerical optimization methods and tools have recently gained vast ground in all fields of mechanical engineering to support process and product design. Novel design approaches in modern industries aim to create high-tech, high quality and innovative products and engineering solutions. The course purpose is to provide students with the necessary fundamental knowledge in the field of mechanical engineering design and optimisation. Upon completion of this course, the students will be able to develop skills on analysing the overall product design cycle including the problem definition, the solution finding and evaluation up to prototype creation, operation and recycling. In this way students will get familiar hands on examples of real modern industrial application. The combination of theoretical knowledge and practical applications will enable students to comprehend the use and benefits of the methodical engineering design and formulate optimization methods to support the solution finding process.				
Learning Outcomes	By the end of the course, students must be able to: 1. Analyze the position of the design process within the company. 2. Describe new ways for planning and designing new products in modern industries. 3. Describe the product planning approach, define product specifications and identify product purposes. 4. Apply embodiment design methods for finding innovating solutions. 5. Setup optimization tasks with modelling and simulations tools. 6. Select appropriate material, generate detail drawings and integrate single components into assemblies during product design. 7. Evaluate the proposed solution and recommend the most appropriate one, based on categorised criteria. 8. Formulate numerical optimization methods for solving design problems efficiently.				
Prerequisites	ME317		Corequisites	None	

Course Content	• The position of the design process within the company The necessity for systematic design, Design methods, Systems theory. • Product planning and clarifying the task General approach. Product definition, Design specification, House of quality, Task clarification • Conceptual design Abstracting to identify the essential problems. Establishing function structures, Developing working structures, Examples of conceptual design, Evaluating designs, Decision making techniques • Embodiment design Basic rules and principles, Guidelines for embodiment design, Materials selection and design, Materials processing and design, Detail design • Parametric design Modelling and Simulation, Cause and effect analysis • Design for Minimum Cost Cost Factors, Fundamentals of cost calculations, Methods for estimating costs • Optimization Unconstrained & constrained optimization, Global and local optima, Steepest descent method, Transformation methods, Strategies for solving optimization problems • Computer Laboratory Work: Individual or small group modelling and problem solving, from selected areas such as structural, heat transfer, fluid mechanics with the use of common industrial packages such as, SOLIDWORKS, ANSYS Workbench and Excel/Matlab
Teaching Methodology	The taught part of course is delivered to the students by means of lectures, conducted with the help of computer presentations. Lecture notes and presentations are available through the e-learning platform for students to use in combination with the textbooks. Furthermore theoretical principles are explained by means of demonstration examples and solution of specific problems. Lectures are supplemented with computer laboratory demonstrations work carried out with the supervision of the lecturer. Here a demonstration of numerical problems on commercial software takes place. Additionally, during the computer laboratory sessions, students apply their gained knowledge and identify the principles taught in the lecture sessions by formulating and appraising specific design optimization problems with the aid of numerical methods.

Bibliography	(a) Textbooks: Engineering Design, Rudolph J. Eggert, Prentice Hall, 2005 Jasbir Arora, Optimization of Structural and Mechanical Systems, World Scientific Publishing, 2007 (b) References: Saeed Moaveni, Finite Element Analysis Theory and Application with ANSYS, Pearson Education, 2008 Engineering Design: A systematic approach, Pahl, Beitz, 2nd Edition, 1999 Engineering Design, A Materials and Processing Approach, G. E. Dieter, McGraw–Hill International Editions, 3rd Edition, 2000 Product Design and Development, Karl Ulrich Steven Eppinger, McGraw-Hill, 2004 Mechanical Design, An Integrated Approach, Ansel C. Ugural, Mcgraw Hill, 2004. Mechanical Engineering Design, Ch. R. Mischke, J. Edward, McGraw-Hill, 7th Edition, 2004 Engineering Design and Problem Solving, 2nd Edition, Steve K. Howell, Prentice Hall, 2002
Assessment	The assessment consists of following methods for both the theoretical and practical part of the course. Each assessment method is assigned with a weight which is used for the calculation of the final grade. Design Project: 20% Mid-term exam: 20% Final Exam (written): 60%
Language	English