PDF - MACHINE DESIGN: REDESIGNED - researchcub.infoMachine design is acornerstone foundation course in any Mechanical Engineering program. Thetraditional objective of this course is to engage students with analysistechniques to guard against specific failure modes or to predict a product'slife cycle based on a loading scenario. Generally, the course is taught byintroduction of a topic first, e.g. static failure criteria, then examples arepresented and homework sets are assigned to allow students to practice andsharpen their problem solving skills. The current methodology lacks theimplementation of the complete engineering design process and the integrationof other knowledge domains such as manufacturing. Additionally, the currentcourse structure does not usually stimulate creativity necessary for the designprocess (ideation) or train students on decision making based on objectivecriteria. This paper presents an enhanced course structure developed over thepast few years for a more comprehensive approach to machine design. The newcourse structure is hinged on the application of engineering design process,knowledge integration from prior courses as well as industrial practice, andadoption of design matrices as an objective decision making tool. We haveretained many of the traditional pedagogies used in teaching machine design andsupplement this educational experience with a significant project componentbased on current customer-need or economical challenge. Through the projectstudents learn to: 1) create the design envelop based on a provided statementor requirement document; 2) define specific, meaningful, and measurable goals;3) synthesize creative ideas to solve the problem; 4) perform a patent searchto verify the innovative nature of their ideas; 5) produce a design matrix withevaluation criteria based on the goals and expected functionality; and 6)perform an in depth engineering analysis based on mechanics of materials,manufacturability, assembly, and packaging. The inclusion of an intensivewriting and presentation experience with critical feedback engages students ina continuous reflection on the elements of the complete design processthroughout the entire semester. It was found that this approach producesstudents who are better prepared for their senior design projects andengineering practice. Students noted an increase in their understanding ofmachine design concepts as an integration of all their prior preparatorytraining. The effectiveness of the revised course structure was evaluatedthrough a survey of previous and current students. Introduction and backgroundPrior to 2011, one of the common concerns of the Mechanical Engineeringdepartment's senior students was the inability to "engineer" or practice"design." This was also echoed by capstone project instructors. In other words,our students were not prepared to work on their senior design projects, unlessthey had prior industrial or volunteering experiences. Students were found tobe unable to develop ideation and design skills independently prior toenrolling in their required culminating experience [1]. At our university, fourdifferent Mechanical Engineering capstone projects are available, all of whichare competition-based. These projects include: Society of Automotive EngineersFormula Car Design and Competition, Intelligent Ground Vehicle Competitionsponsored by IGVC, American Society of Mechanical Engineers Human PoweredVehicle Design and Competition, and AUVSI Unmanned Aerial Vehicle Competition.P ge 26102.2 2 The inability of engineering graduates to engineer and design hampersthe industrial productivity in the United States [1], since these students lackthe ideation, design and practical skills that are in great demand by currentemployers. This issue is rooted in the lack of preparatory courses thatinculcate the design process in our students early in their educationalprogram. The traditional focus is on the important appropriate scientific andanalytical techniques with little regard to the complexity of the designprocess and its applications. Traditionally, machine design courses, wheredesign in some instances is first introduced, are focused on the analysis ofstresses due to applied loads, static failure theories for ductile and brittlematerials, fatigue, and analysis of mechanical components, such as shafts, fasteners,gears, etc. [2]. Notably, mechanical design textbooks are full of practicalknowledge but it is presented solely from the perspective of performing acareful detailed analysis. Academic professors without considerable industrialexperience promotes the basics of problem solving, in other words the ‘scienceof analysis’ [2]. Those academicians with extensive industrial experienceunderstand the critical role design plays in the understanding of mechanicaldesign and are able to share this experience with their students but may notpossess the breadth of experience to cover all of the content equally in a fullterm course. As a result a large gap exists between the senior designexperience and industry expectation and the knowledge attained in a typicalmachine design course. The design process, sometimes referred to as the designcycle, exposes engineering students to two important lessons: 1) the design isiterative process [3]; and 2) design is a process of tradeoffs. In a typicaldesign exercise, more than one solution exists and an engineer is expected toobjectively evaluate all suitable solutions and decide on which to move forwardwith, i.e., tradeoff. Thereafter, the selected conceptual design is modeled andanalyzed in detail. The design cycle thus consists of two symbiotic phases:synthesis and analysis. Furthermore, the design will continuously evolvethrough many iterations until the final design meets all the established designcriteria. If an engineering student approaches a project beginning with thefoundation of the design process, involving iteration and trade-off throughsynthesis and analysis, the result is an engineer who is ready to contribute tothe workforce on the first day on the job. Figure 1: Engineering Design Cycle(modified from [3]). Figure 1 depicts one model of the steps of the designprocess [3]. The design project topic is introduced at the earliest opportunityat the start of the term. The project topic may range from relatively simple toextremely complex in its subtleties. The intent is to stimulate ideation and Pge 26102.3 3 finding solutions to issues that arise every step of the way inteamwork setting. Each group consists of 3-5 students. The project provides aterm long framework whereby all of the elements of mechanical design can beintroduced with contextual relevance. It begins with the definition of theoverall objective of the project. In this step, the design requirement documentis carefully reviewed and questions or concerns are articulated and communicatedto the customer (the instructor). In our experience, most students nevercontemplate additional possibilities or alternatives when a design task isassigned. This is of high importance to the consumer or contractor who isexpecting to be involved in the decision making process even though they mightnot completely comprehend the complexities of a proposed design. In therequirement document, the overall customer need, problem or challenge isspecified as well as the machine functionality, design constraints, rules andregulations, and allocated resources such as budget and timeline. Once therequirement document is well-understood, the design team needs to define theoverall design goal. It is encouraged that specific, meaningful, andmeasureable (SMM) goals to be defined. Here, in an academic setting, theprofessor can assist the students in thinking, focusing on and defining SMMgoals in design courses. The second step is choosing an appropriate designstrategy, in which the decision must be made whether the product is going to bemechanical, electrical, software, or hybrid, such as an automated machine orprocess. The design approach must be decided as well, whether top-down orbottom up. Additionally, decisions must be made regarding manufacturing processesversus the use of commercially available components. The third step iscollecting information and conducting research about the design strategy andall components and subsystems. Moreover, in this step, research needs to beconducted about theories, techniques, and scientific principles to facilitatethe subsequent steps in the design. We argue that devoting appropriate time andeffort in the first three steps of the process will have a significant impacton the design by shortening the overall project time and reducing the number ofiterations required. The result will be a more efficient process leading to thefinal product design that meets all the required design criteria. Put anotherway, the first three steps in design process should be allocated enoughresources, in effect time, funds, effort, expertise, to achieve “lean design,”and making informed decisions. Only then, initial design attempts are done. Ifthe preceding steps are executed correctly, the initial attempts will satisfythe design requirements with implied novelty, involving creative and innovativesolutions. In the initial attempt and based on the research, the designer isnow considering the manufacturing, assembly, and the packaging as well as theloading scenarios. These first four steps constitute the synthesis phase of thedesign cycle. Subsequently, the selected solution can be analyzed based on theloading scenarios and environmental conditions to define the shape, size, andmaterials.

MACHINE DESIGN: REDESIGNED

number (in which instructions will sent to you to download the material) to +234 70 6329 8784 via text message/ whatsapp or Email address: info@allprojectmaterials.com.
Once payment is confirmed, the material will be sent to you immediately.
It takes 5min to 30min to confirm and send the material to you.
For more project topics and materials visit: https://researchcub.info/ or For enquries: info@allprojectmaterials.com or call/whatsapp: +234 70 6329 8784
Regards!!!