ME 4020(5020) Applied Machine Design

Prerequisites: ME 3050, ME 4010. Design for strength and rigidity under dynamic loads; shaft design; design of joints (threaded fasteners, welds, springs, keys, etc.); design of gear trains; lubrication and bearing design; finite element analysis; optimization, statistical consideration in design. [Required Course]

Prerequisites by Topic:
1. Mechanics of materials
2. Material science and manufacturing processes
3. Static and fatigue failure theories
4. Dynamics of machinery and vibrations
5. Engineering graphics

Textbook and Resources:
Course notes and resource materials listed below:
Mechanical Engineering Design, J.E. Shigley
Engineering Design and Design for Manufacturing: A Structured Approach, J.R. Dixon
CAE/CAD Software Online Manuals

Course Objectives:
This course provides a significant design experience utilizing primarily computer-aided design, mechanics of materials, dynamics and vibrations, failure theories for strength, rigidity, and fatigue, and common machine elements. It adds the dimension of design optimization. Its major objectives are to draw together the student's experience in the fundamental subjects and to involve the student in the design of mechanical systems, devices and/or components encompassing real life decision-making; including constraint specification and consideration of economic factors in engineering design.

Course Topics:
T1. Design philosophy, processes, optimization (10%)
T2. Case studies in design for strength, rigidity, fatigue (10%)
T3. Shaft design (10%)
T4. Joint design (e.g. threaded fasteners, welds) (15%)
T5. Spring design and selection (10%)
T6. Advanced mechanical elements (e.g. bearings, gears) (15%)
T7. Codes and standard practices (5%)
T8. Applications of computer-aided design (25%)

Class/Lab Schedule:
Minimum student contact time - 3360 minutes

Course Outcomes:
Upon completion of this class, the student will be able to:
C1. Define, recognize and distinguish the various activities embodied in a general design methodology and encountered in a real design process. [c,g,k]
C2. Specify material and manufacturing methods for mechanical components based on strength, rigidity, fatigue, and reliability considerations. [c,g,k]
C3. Apply computer-aided design tools to define and analyze mechanical components.[a,c,e,k]
C4. Size and select joints, shafts, springs, and other advanced mechanical elements for a specific application. [a,c,e,k]
And have gained experience with and/or exposure to:
C5. The influence of codes and standard practices on the engineering design process [f,i]
C6. The potential impact of ethical and societal concerns on the engineer and engineering design process [f,i]
C7. Working, as part of a team, on a project, report, or other small group assignment [c,d,g,i]
C8. The preparation and delivery/submission of written and/or oral presentations [d,g,i]

Professional Component:
This course is required of Mechanical Engineering students who elect to follow an Area of Concentration (AOC) related to "mechanical systems". It involves the integration of foundational course material within a design context, and is preparatory to and a prerequisite for the students' "culminating (major) design experience" in ME 4440 Senior Design Project.
Contribution of Course to Meeting the Professional Component:
Math and Basic Science:
General Education:
Engineering: 3 credit hours. This course contains significant design.
Other:

Relation to Program Objectives:
This course goes beyond the presentation of basic "analytical" skills, to incorporate experience in critical thinking (integration of analytical skills, quantitative and qualitative evaluation of alternatives, impact assessment) and communication (written/oral presentations, location and acquisition of information through direct contact with external sources/individuals). As a consequence, students who successfully complete this class should be more comfortable, confident and productive when engaged in career activities that involve: self-education, teamwork, and interaction with engineering and non-engineering communities and individuals.

5000-Level Credit:
Students registered for 5000-level credit will be given additional assignments commensurate with a graduate-level course. The exact nature of these assignments will be specified by the instructor in the Course Policy for that semester.

Course Coordinator: Undergraduate Program Committee

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