Mechanical Engineering Department

ME 304 Mechanical Engineering Design I

Course Syllabus

Course Description: ME 304 (3,1,0) (Engineering topics)
Introduction to design: design process, problem formulation, engineering model, factors of safety and codes, overall design considerations; Stresses: stress concentration factors, residual stresses; Deflection and Stiffness; Stability and Buckling; Theories of failure: failure under static loading, fatigue loading; fracture mechanics.

ME 304 (Mechanical Engineering Design I) is a 3-credit hour (3 weekly lectures and 1 tutorial session) third-year course. The course is designed to introduce students to the concepts of design of mechanical elements that includes the definition of stress, strength and safety factor. Theories of failure under static loading for ductile and brittle materials define the conditions for designing mechanical element under general state of stress. Design of elements under specific conditions such as deflection and buckling are introduced. Design of shafts under static and fatigue conditions are covered. Throughout the semester, students are required to submit homework assignments and take frequent quizzes. Such activities along with the solved examples in lectures are intended to give the student the required practice in handling and tackling various design problems and contribute to the achievement of student outcomes SO1 and SO2.

Number of Credit: 3 hr
Course type: Core Course
Prerequisites by Course
ME 352 Mechanics of Materials

Prerequisites by Topic
1. Stress under various loading conditions
2. Stress transformation

Textbook(s)/ Required Material
1. R. C. Hibbeler. Mechanics of Materials, SI Edition (Latest).
2. J. E. Shigley, C. R. Mischke and R. G. Budynas, Mechanical Engineering Design, 9th Edition, McGraw Hill, 2008.

Topics Covered
1. Introduction to design
2. Theory of Failure: Static Loading *(3 weeks)*
3. Beam and Shaft Design *(2 weeks)*
4. Deflection of Beams and shafts *(2 weeks)*
5. Stability of Structures: Buckling of Columns *(2 weeks)*
6. Energy Methods *(2 weeks)*
7. Theory of Failure: Dynamic Loading *(3 weeks)*
8. Introduction to Fracture Mechanics *(1 weeks)*

Course Objectives
(Entries in brackets are links to program educational objectives)

Students who complete this course will:

1. Have the necessary basic knowledge to continue their instruction in the field of Mechanical design [1].
2. Have the ability to acquire new knowledge in a professional manner [2].
3. Have the knowledge to solve engineering problems under various loading conditions [3].

Course Learning Outcomes:

	ABET SOs	SO1	SO2	SO3	SO4	SO5	SO6
CLO # 1	Use the appropriate failure theory for **static loading** for designing any load bearing component for both ductile and brittle materials.	x					
CLO # 2	Recognize the principals of machine components design considering multi-objectives, multi-constraints and **safety factors.**	x					
CLO # 3	Calculate **deflections in beams** and shafts and select the most appropriate method for achieving this.		x				
CLO # 4	Analyze **columns integrity** when subjected to concentric and eccentric compressive loads.		x				
CLO # 5	Apply standard **energy methods** to analyze machine components subjected to static and impact loading.		x				
CLO # 6	Evaluate the **fatigue performance** of materials considering stress concentrations and endurance modification factors		x				

Class/Laboratory Schedule
Three 50-minute lecture sessions and one 50-minute tutorial session per week.

Computer usage
Students are encouraged to use Engineering Equation Solver (EES) in homework assignments.

Science/Design Contents
Engineering Science: 0%
Engineering Design: 100

Assessment Tools
Two mid-term exams: 40%
Homework and quizzes: 20%
Final exam: 40%

Prepared by
Dr. Mahmoud S. Soliman, Dr. F. Benyahia and Dr. Shahid Parvize

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Underline parts in SOs which assessed in each CLOs

CLOs		SO1/ S1	SO2/ S2
1	Use the appropriate failure theory for **static loading** for designing any load bearing component for both ductile and brittle materials.	SO1. An ability to identify, formulate, and solve **complex** engineering problems by applying principles of engineering, science, and mathematics.	
2	Recognize the principals of machine components design considering multi-objectives, multi-constraints and **safety factors.**	SO1. An ability to identify, formulate, and solve **complex** engineering problems by applying principles of engineering, science, and mathematics.	
3	Calculate **deflections in beams** and shafts and select the most appropriate method for achieving this.		SO2. An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.
4	Analyze **columns integrity** when subjected to concentric and eccentric compressive loads.		SO2. An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural,

			social, environmental, and economic factors.
5	Apply standard **energy methods** to analyze machine components subjected to static and impact loading.		SO2. An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.
6	Evaluate the **fatigue performance** of materials considering stress concentrations and endurance modification factors		SO2. An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.

Methods of assessment of course syllabus

Assessment Method	Number/Type	Instructor Assessed	TA/Grader Assessed	Peer/Self Assessed
Homework	At least 10 HWs		√	
Mid Terms/Final Exams	2 mid term; 1 final exam	√		
Quizzes	Up to 5 quizzes		√	
Individual Projects				
Team Projects				
Lab Assignments				
Computer Assignments				
Computer Tools Used				
Oral Presentations				
Written Reports				
Other				