Course Specification
(Bachelor)

Course Title:	Machine Design 1
Course Code:	ME3136
Program:	Mechanical Engineering
Department:	Mechanical Engineering
College:	Engineering and Architecture
Institution:	Umm Al-Qura University
Version:	*Course Specification Version Number*
Last Revision Date:	04/02/2025

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A. General information about the course:

1. Course Identification

1. Credit hours: (3 hours)					
2. Course type					
A.	☐ University	☐ College	☒ Department	☐ Track	☐ Others
B.	☒ Required		☐ Elective		
3. Level/year at which this course is offered: (Level8/ year4)					
4. Course General Description:					
Machine Design I introduces students to the fundamental principles of designing mechanical components and systems. The course focuses on the analysis, selection, and design of machine elements such as shafts, keys, coupling, springs, belt drives,clutches, power screws and fasterns and joints. Students will learn to apply engineering standards, material properties, and safety factors to create reliable and efficient designs.					
5. Pre-requirements for this course (if any)**:**					
Mechanics of Materials, and Mechanical Drawing					
6. Co-requisites for this course (if any)**:**					
7. Course Main Objective(s):					
By the end of this course, students will be able to: **1. Understand the fundamental principles of machine design and their application to mechanical components.** **2. Analyze and design basic machine elements shafts, keys, coupling, springs, belt drives,clutches, power screws and joints.** **3. Apply material properties, stress analysis, and failure theories to ensure safe and reliable designs.** **4. Use engineering standards and design codes to create practical and manufacturable solutions.** **5. Develop problem-solving and critical thinking skills through hands-on design projects and assignments.**					

2. Teaching mode (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	Lecture (30 hours) Tutorial (45 hours)	100%
2	E-learning		
3	Hybrid • Traditional classroom • E-learning		
4	Distance learning		

3. Contact Hours (based on the academic semester)

No	Activity	Contact Hours
1.	**Lectures**	30
2.	**Laboratory/Studio**	
3.	**Field**	
4.	**Tutorial**	45
5.	**Others (specify)**	
Total		75

B. Course Learning Outcomes (CLOs), Teaching Strategies and Assessment Methods

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
1.0	**Knowledge and understanding**			
1.1	Able to recognize and understand the principles of machine component design and analysis.	K1	Traditional Lecture	Homework, Quizzes, Mid-Term exam, Final Exam
1.2	Able to utilize the application of stress analysis in machine elements under single loading or combine loading conditions.	K1	Traditional Lecture /Classroom Activity	Homework, Quizzes, Mid-term exam, Final Exam

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
1.3	Able to understand and utilize failure theories and determining the corresponding factor of safety	K1	Traditional Lecture /Classroom Activity	Homework, Quizzes, Mid-term exam, Final Exam
1.4	Able to recognize how a machine element can behave under dynamics loading.	K1	Traditional Lecture /Classroom Activity	Homework, Quizzes, Mid-term exam, Final Exam
1.5	Able to comprehend and understand the concepts, procedures, data and design analysis necessary to design a Shaft, Couplings, Belt drive.	K1	Traditional Lecture /Classroom Activity	Homework, Quizzes, Mid-Term exam, Final Exam
2.0	**Skills**			
2.1	Able to identify, formulate, and solve machine component design problems.	S1	Traditional Lecture / Examples	Project
2.2	Able to apply analytical knowledge through force and stress analysis in machine component design.	S1	Traditional Lecture / Examples	Project
2.3	Able to demonstrate the use of techniques, skills, and modern engineering tools necessary for engineering practice.	S3	Traditional Lecture / Examples	Project
3.0	**Values, autonomy, and responsibility**			
3.1	Able to apply principle of design knowledge in solving mechanical component design problems.	V1	Traditional Lecture /Problem Statements Examples	Project
3.2	Able to apply analytical skill and		Traditional Lecture / Examples	Project

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
	associated formulation as well communicates effectively in design project.	V1,V2		
...				

C. Course Content

No	List of Topics	Contact Hours
1.	**Introduction to Mechanical Engineering Design:** • Classifications of Design. • Phases of Design. • Design Factor of Safety. Mechanical Properties of Materials.	6
2.	**Load and Stress Analysis:** • Shearing Forces and Bending Moment Diagrams. • Axial Load, Torsion, Bending, and Transverse shear. • Combined Loadings. Stress and Strain Transformation.	6
3.	**Failures Theories due to Static Loading:** • Failures Theories. • Maximum Normal Stress Theory. • Maximum Shear Stress Theory. • Distortion Energy Theory. • Factor of Safety for each Failures Theory. Design Against Fatigue Failure.	6
4.	**Shaft Design:** • ASME Shaft Equations. • Design of Shaft for Torsional Rigidity. • Standard Sizes of Shafts. Bending and Torsional Moment.	12
5.	**Coupling Design:** • Rigid Coupling. • Flexible Coupling. Analysis of Bolt.	9
6.	**Belt drive**: • Belt and Type of Belt. • V-Belt · Belt Design. Other components (key, pins and splines).	9
7.	**Spring Design:** • Types of springs: helical, leaf, and torsion • Stress analysis and deflection calculations	**9**

	• Design for static and dynamic loading • Applications of springs in mechanical systems	
8.	**Fasteners and Joints** • Types of fasteners: bolts, screws, and rivets • Thread standards and terminology • Preload, torque, and stress analysis in bolted joints • Design of welded and riveted joints	**9**
9.	**Power screws** • Types of Power Screws • Load Analysis & Stress Analysis • Friction and Efficiency • Self-Locking	**9**
Total		

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	Quiz 1	2	2.5%
2.	Quiz 2	4	2.5%
3.	Quiz 3	6	2.5%
4.	Midterm Test	8	25%
5.	Quiz 4	10	2.5%
6.	Quiz 5	12	2.5 %
7.	Quiz 6	14	2.5 %
8.	Project	15	20%
9.	Final Exam	16	40%

*Assessment Activities (i.e., Written test, oral test, oral presentation, group project, essay, etc.).

E. Learning Resources and Facilities

1. References and Learning Resources

Essential References	Richard G.Budynas and J.Keith Nisbett, Shigley's Mechanical Engineering Design, 9th edition in SI Units, McGraw-Hill, 2011
Supportive References	ASME (Codes & Standards)
Electronic Materials	• Robert L.Mott, Machine Elements in Mechanical Design, International edition, 2004. • M.F.Spotts, T.E.Shoup, and L.E.Hornberger, Desin of Machine Elements, 8th edition, Pearson-Prentice Hall, 2004.

	• Jack A.Collins, Mechanical Design of Machine Elements and Machines, John Wiley & Sons, 2003. Robert C.Juvinall and Kurt M.Marshek, Fundamentals of Machine Component Design, Updated 3rd edition, John Wiley & Sons, 2000
Other Learning Materials	

2. Required Facilities and equipment

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	Lecture room which is equipped with LCD Projector, Laptop, white-board, and internet.
Technology equipment (projector, smart board, software)	Data show, CAD software (ex. Autodesk Inventor or solid works), and Microsoft Excel
Other equipment (depending on the nature of the specialty)	

F. Assessment of Course Quality

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	Students and program leaders	Direct (quizzes, exams, projects, HW assignments
Effectiveness of Students assessment	Students and program leaders	Indirect (End of Term Survey)
Quality of learning resources	Program leaders	Direct (CLOSO folder analysis)
The extent to which CLOs have been achieved		
Other		

Assessors (Students, Faculty, Program Leaders, Peer Reviewers, Others (specify)

Assessment Methods (Direct, Indirect)

G. Specification Approval

COUNCIL /COMMITTEE	DR.HANI ALHAZMI
REFERENCE NO.	
DATE	**04/02/2025**