



# Course Specification

## (Bachelor)

Course Title: **Mechanics of Materials**

Course Code: **COE 2104**

Program: **Bachelor of Construction Engineering**

Department: **Civil and Environmental Engineering Department**

College: **College of Engineering and Computing in Al-Qunfudhah**

Institution: **Umm Al-Qura University**

Version: **4.0**

Last Revision Date: **14 January 2025**

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## A. General information about the course:

### 1. Course Identification

1. Credit hours: 3.0

### 2. Course type

A.  University  College  Department  Track Others

B.  Required  Elective

3. Level/year at which this course is offered: (Second Year / Level 4)

### 4. Course General Description:

This course covers essential concepts in mechanics of materials, including stress, strain, and constitutive relations. Key topics include:

- Axially Loaded Members: Stress, strain, and deformation.
- Thermal Stresses: Effects of temperature changes on structural elements.
- Pressure Vessels: Stress analysis of thin and thick-walled pressure vessels.
- Energy Methods: Concepts related to strain energy and virtual work.
- Torsion: Torsional deformation of circular and thin-walled sections.
- Beam Analysis: Shear and bending moment diagrams, elastic bending, and shear stress distribution.
- Compound Stresses and Stress Transformation: Principal stresses, Mohr's circle, and combined loading.
- Deflection of Beams: Analytical methods for beam deflection, including singularity functions.

### 5. Pre-requirements for this course (if any):

Statics (COE2102)

### 6. Co-requisites for this course (if any):

None

### 7. Course Main Objective(s):

The primary objective of this course is to equip students with a solid understanding of the fundamental theories and techniques in mechanics of materials. By the end of the course, students will be able to:

- Compute stresses, strains, and deformations in structural members under various loading conditions.
- Apply energy concepts in structural analysis.
- Analyze stress transformations and understand material behavior under complex stress states.



## 2. Teaching mode (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	75	100%
2	E-learning		
3	Hybrid <ul style="list-style-type: none"> <li>Traditional classroom</li> <li>E-learning</li> </ul>		
4	Distance learning		

## 3. Contact Hours (based on the academic semester)

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

## 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
<b>1.0</b>	<b>Knowledge and understanding</b>			
1.1	Ability to demonstrate understanding the behavior of ductile and brittle materials and the required experimentation	K2	Interactive learning Self-directed learning	Quizzes, Assignments, Midterm Exam, Final Exam
1.2	Ability to examine sound understanding of Mohr's circle application in stress transformatio	K2	Interactive learning Self-directed learning	Quizzes, Assignments, Midterm Exam, Final Exam
<b>2.0</b>	<b>Skills</b>			
2.1	Evaluate the aspects of bending, torsion, deflection, and stability.	S3	Interactive learning	Quizzes, Assignments, Midterm





Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
2.2	Find slope and deflection by solving flexure equation with integration method	S2	Self-directed learning	Exam, Final Exam, Lab exam
2.3	Determine the principal stress and maximum shear stress for 2D element	S1		
2.4	Draw shear force and bending moment diagrams for beams	S2		
2.5	Evaluate normal, shear, bending stresses and combined stresses	S3		
3.0	Values, autonomy, and responsibility			
3.1	N/A			

### C. Course Content

No	Topics	Subtopics	Contact Hours
1.	<b>Stress</b>	1.1 Introduction of deformable body 1.2 Average, normal, and shear stress 1.3 Allowable stress design	7
2.	<b>Strain</b>	2.1 Normal strain and shear strain 2.2 Cartesian strain components 2.3 Small strain analysis	7
3.	<b>Mechanical Properties of Materials</b>	3.1 Tension and compression test 3.2 Stress-strain diagram 3.3 Stress-strain behavior of ductile and brittle materials 3.4 Hooke's law 3.5 Strain energy 3.6 Poisson's ratio	7
4.	<b>Axial Load</b>	4.1 Saint-Venant's principle 4.2 Elastic deformation of axially loaded members 4.3 Principle of superposition, statically indeterminate axially loaded member 4.4 Thermal stress 4.5 Stress concentrations	7



5.	<b>Torsion</b>	5.1 Torsional deformation of a circular shaft 5.2 The torsion formula 5.3 Power transmission	7
6.	<b>Bending</b>	6.1 Shear and moment diagrams 6.2 Bending deformation of straight members 6.3 The flexure formula	7
7.	<b>Transverse Shear</b>	7.1 Shear in straight members 7.2 The shear formula and its limitations	7
8.	<b>Combined Loadings</b>	8.1 Thin-walled pressure vessels 8.2 State of stress caused by combined loading	7
9.	<b>Stress Transformation</b>	9.1 Plane stress transformation and its general equation 9.2 Principal stress and maximum in-plane shear stress 9.3 Mohr's circle for plane stress	7
10.	<b>Deflection of Beams and Shafts</b>	10.1 The elastic curve 10.2 Slope and deflection by integration 10.3 Concept of discontinuity functions (singularity functions)	7
11.	<b>Lab and Midterm exams</b>		5
<b>Total</b>			<b>75</b>

#### D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	Quizzes	3, 10	10%
2.	Assignments	Each week	10%
3.	Midterm Exam	8	20%
4.	Lab Exam	15	20%
5.	Final Exam	16 or 17	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

<b>Essential References</b>	Hibbeler, R. C. (2022). Mechanics of materials (11th ed.). Pearson.
<b>Supportive References</b>	1. Limbrunner, G., & D'Allaird, C. (2021). Applied statics and strength of materials (7th ed.). Pearson Prentice Hall. 2. Goodno, B. J., & Gere, J. M. (2020). Mechanics of materials (Enhanced 9th ed.). Cengage Learning.





Electronic Materials

Other Learning Materials

## 2. Required Facilities and equipment

Items	Resources
<p><b>facilities</b> (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)</p>	<ul style="list-style-type: none"> <li>- Well-equipped classroom with whiteboards, projectors, and seating for all students.</li> <li>- Mechanics of Materials Lab with equipment such as tensile testing machines, torsion testing apparatus, strain gauges, and deflection measurement devices.</li> <li>- Physical models of beams, shafts, pressure vessels, and other structural components for demonstrations.</li> </ul>
<p><b>Technology equipment</b> (projector, smart board, software)</p>	<ul style="list-style-type: none"> <li>- Projector, audio system for lectures, and display screens for presenting diagrams and videos.</li> <li>- Computers or access to simulation software for stress analysis and finite element modeling.</li> <li>- Access to course textbooks, supportive references, journals, and online databases.</li> <li>- Stable internet connection for accessing digital resources, simulations, and reference material.</li> </ul>
<p><b>Other equipment</b> (depending on the nature of the specialty)</p>	

## F. Assessment of Course Quality

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	Lecturer / Students	Direct / Indirect (Grades, surveys)
Effectiveness of Students assessment	Faculty	Indirect (Barriers to understand successor course)
Quality of learning resources	Lecturer	Direct (Grades)





Assessment Areas/Issues	Assessor	Assessment Methods
The extent to which CLOs have been achieved	Lecturer / Faculty	Direct (Grades)
Other		

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

**Assessment Methods** (Direct, Indirect)

### G. Specification Approval

<b>COUNCIL /COMMITTEE</b>	Civil and Environmental Engineering Department Council in Al-Qunfudah
<b>REFERENCE NO.</b>	The fifteenth session of the academic year 1446
<b>DATE</b>	01/05/2025

