University of Engineering & Technology, Taxila
Department of Civil Engineering

Strength of Material-I (CE-207)

Course Contents:

- Types of stresses and strains
- Statically indeterminate problems
- Mechanical Properties of materials
- Thermal stresses
- Advanced cases of shearing forces and bending moment diagrams for determinate beams
- Relationship between load, shear force and bending moment
- Torsion in circular sections
- Strain Energy
- Distribution of flexural stress in beams
- Distribution of Shear stresses in beams
- Deflection and rotation of beams using double integration, moment area, conjugate beam method and by principle of superposition
- Combined bending and direct stresses
- Columns, types (Short, long and indeterminate), critical load for columns, End conditions of columns
- Strain energy due to direct load, shear, bending and torsion

Course Learning Outcomes
Theory Part

Course Learning Outcomes are as listed below:

CLO 1: Understand the material properties and use for various purposes in structures and machine parts.

CLO 2: Analyze and design structural members subjected to tension, compression, shear, axial, torsion, bending and combined stresses using the fundamental concepts of stress, strain and elastic behavior of materials.

CLO 3: Utilize appropriate materials in design considering engineering properties, sustainability, cost and weight.

CLO 4: Perform engineering work in accordance with health, safety and economic constraints related to the design of structures and machine parts.

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Program learning outcomes (PLOs) For B.Sc. Civil Engineering

PLO 1: Apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems **(engineering knowledge)**

PLO 2: Identify, formulate, research literature and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences **(problem analysis)**

PLO 3: Design solutions for complex engineering problems and design systems, components or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal and civil engineering considerations **(design/development of solutions)**

PLO 4: Conduct investigations of complex problems using research based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of information to provide valid conclusions **(investigation)**

PLO 5: Create, select and apply appropriate techniques, resources, modern engineering and IT tools, including prediction and modeling, to complex engineering activities, with an understanding of the limitations **(modern tool usage)**

PLO 6: Apply reasoning informed by contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional engineering practice **(engineer and society)**

PLO 7: Understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate knowledge and need for sustainable development **(environment and sustainability)**

PLO 8: Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice **(ethics)**

PLO 9: Function effectively as an individual, and as a member of leader in diverse teams and in multi-disciplinary setting **(individual and team work)**

PLO 10: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instruction **(communication)**

PLO 11: Demonstrate knowledge and understanding of engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments **(project management)**

PLO 12: Recognize the need for, and have to preparation and ability to engage in independent and life-long learning in the broadest context of technological change **(lifelong learning)**

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Mapping of PLO and CLO (Theory Part)

CLO's / PLO's	CLO 1	CLO 2	CLO 3	CLO 4
PLO 1 (Engineering Knowledge)	√	√	√	√
PLO 2 (Problem Analysis)		√	√	
PLO 3 (Design/Development of Solutions)		√	√	√
PLO 4 (Investigation)	√			
PLO 5 (Modern Tool Usage)				
PLO 6 (The Engineer and Society)				
PLO 7 (Environment and Sustainability)				√
PLO 8 (Ethics)				
PLO 9 (Individual and Team work)				
PLO 10 (Communication)				
PLO 11 (Project Management)				
PLO 12 (Lifelong Learning)				

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Course Learning Outcomes
Practical Part

Course Learning Outcomes are as listed below:

CLO 1: To study the mechanical properties of various structural materials for better utilization in structures and machines.

CLO 2: Utilize appropriate materials in design considering engineering properties, sustainability, cost and weight.

CLO 3: To select materials in accordance with health, safety and economic constraints related to the design of structures and machine parts.

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Mapping of PLO and CLO (Practical Part)

CLO's / PLO's	CLO 1	CLO 2	CLO 3
PLO 1 (Engineering Knowledge)	√	√	
PLO 2 (Problem Analysis)			
PLO 3 (Design/Development of Solutions)	√	√	√
PLO 4 (Investigation)	√		
PLO 5 (Modern Tool Usage)			
PLO 6 (The Engineer and Society)			
PLO 7 (Environment and Sustainability)			√
PLO 8 (Ethics)			
PLO 9 (Individual and Team work)			
PLO 10 (Communication)			
PLO 11 (Project Management)			
PLO 12 (Lifelong Learning)			

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Weekly Lesson Plan (Theory Part)

Week	Lecture
01	Introduction
02	Types of stresses
03	Types of strains
04	Mechanical properties of materials
05	Statically Indeterminate members
06	Thermal Stresses
07	Torsion of circular sections
08	Shear force and Bending moment
09	Flexural Stress distribution in beams
10	Shear Stress distribution in beams
11	Deflection in beams by Double integration method
12	Deflection in beams by Area Moment Method
13	Deflection in beams by Conjugate beam and superposition method
14	Combined stresses and strain energy
15	Columns
16	Discussions

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Weekly Lesson Plan (Theory Part)

Week	Lab
01	Layout of laboratory
02	Study of materials
03	Study of materials
04	Use of verner caliper and screw gauge
05	Use of verner caliper and screw gauge
06	Study of Mechanical properties
07	Study of Mechanical properties
08	Bend test
09	Bend test
10	Torsion of circular sections
11	Torsion of circular sections
12	Modulus of rupture
13	Modulus of rupture
14	Deflection in beams
15	Deflection in beams
16	Behavior of columns