

**Theory of Structures-I (CE-206)**

**Course Contents:**

- Introduction to structural analysis
  - Definition, type of structures, structural idealization, loads, determinacy, indeterminacy and stability of structures
- Analysis of determinate trusses, common types of trusses, classification of coplanar trusses, method of joints, method of section, graphical method for analysis
- Analysis of statically determinate rigid jointed plane frame
  - Determinacy and stability of plane frames, analysis (sign convention etc), shear and bending moment diagrams of frame.
- Deflection diagrams and elastic curves
  - Energy methods to compute deflection, Castigliano's theorem for trusses, beams and frames, principle of virtual work for trusses, beams and frames.
- Moving loads
  - Influence lines for statically determinate beams, and planar girders, ILD for shear, reaction and bending moment for beams and planar girders
  - ILD for axial forces for trusses. Calculation of maximum stress functions that is reaction, shear and bending moment in a simply supported beam due to series of moving loads, absolute maximum bending moment and its evaluation.
- Arches, Cables and suspension bridges
  - Three hinged parabolic and circular arches, ILD for three hinged arches. Introduction to cables and suspension bridges.

**Course Learning Outcomes (Theory Part)**

Course Learning Outcomes are as listed below:

**CLO 1:** Understand the concepts of idealization in structures and basic mechanism of different loadings.

**CLO 2:** Analyze the structural members subjected to compression, tension, shear and bending using the fundamental concepts of structural analysis.

**CLO 3:** To apply appropriate engineering solutions to solve the problems of stability, safety of structural elements.

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

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

**Course Learning Outcomes (Practical Part)**

Course Learning Outcomes are as listed below:

**CLO 1:** Understand the concepts of idealization in structures and basic mechanism of different loadings.

**CLO 2:** Analyze the structural members subjected to compression, tension, shear and bending using the fundamental concepts of structural analysis.

**CLO 3:** To apply appropriate engineering solutions to solve the problems of stability, safety of structural elements.

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

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**Mapping of PLO and CLO (Practical Part)**

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

**Weekly Lesson Plan (Theory Part)**

<b>Week</b>	<b>Lecture Schedule</b>
01	Introduction to structural analysis. Definition, type of structures, structural idealization
02	Loads: Dead, live, one-way & two-way load distribution, snow load, earth-quake load, live load reduction factor.
03	Determinacy, indeterminacy and stability of structures
04	Analysis of determinate trusses, common types of trusses, classification of coplanar trusses
05	Analysis of trusses by method of joints, Introduction to method of section
06	Analysis of trusses by method of section (continued), graphical method for analysis
07	Introduction to analysis of statically determinate rigid jointed plane frame, Determinacy and stability of plane frames
08	Analysis (sign convention etc), shear and bending moment diagrams of frame.
09	SFD & BMD practice for frames
10	Introduction to deflection diagrams and elastic curves. Energy methods to compute deflection. Castigliano's theorem for trusses.
11	Castigliano's theorem for beams and frames. Principle of virtual work for trusses, beams and frames.
12	Moving loads Influence lines for statically determinate beams, and planar girders, ILD for shear, reaction and bending moment for beams and planar girders
13	Calculation of maximum stress functions that is reaction, shear and bending moment in a simply supported beam due to series of moving loads, absolute maximum bending moment and its evaluation.
14	Introduction to Arches. Three hinged parabolic and circular arches
15	Introduction to cables and suspension bridges.
16	Discussion on problems from entire course

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**Weekly Lesson Plan (Practical Part)**

<b>Week</b>	<b>Lab Schedule</b>
01	Lab Layout
02	Familiarization with loads
03	Introduction to trusses
04	To determine the forces in members of statically determinate truss and comparison of experimental and theoretical values.
05	To determine the forces in members of statically determinate truss and comparison of experimental and theoretical values.
06	To determine the deflection of various beams
07	To determine the deflection of various beams (continued)
08	Quiz, Examining Notebooks
09	To determine the deflection on open square frame
10	To determine the deflection on S-frame
11	To verify the value of influence line for shear force in beams
12	To verify the value of influence line for bending moment in beams
13	Quiz, Examining Notebooks
14	To determine the vertical and horizontal reactions in an arch
15	To determine the tension in cable in case of suspension bridge
16	Lab assignment and Viva