<table>
<tr><th colspan="4">Identification of the subject</th></tr>
<tr><td colspan="3">Name of the subject: Theory of Structure</td><td>Course code: INC-309</td></tr>
<tr><td colspan="3">Academic Area: Engineering</td><td>Course programming: 2016</td></tr>
<tr><td colspan="3">Program: Civil Engineering</td><td rowspan="3">Credit Hours: 4
Theoretical Hours:44

Practical Hours: 0</td></tr>
<tr><td colspan="3">Module: Structure</td></tr>
<tr><td colspan="3">Module Competences:
1- Trains to identify, formulate and solve civil engineering problems.
2- Designs a structural system to satisfy needs with real limitations, including economic, environmental, social, political, ethical, health and safety, construction and sustainability.
3- Understands the ethical and professional responsibility for an adequate performance of their professional activity.
4- Trains to use the techniques, skills and modern tools of current engineering.</td></tr>
<tr><td colspan="3" rowspan="2">Description:
Study of the methods of analysis of statically determined and isostatic structures, truss analysis, energy methods, shear force diagrams, bending moment, torsional moment and axial loads, conjugate beam method, simple frames analysis.

Grading methodology: practices and a final project will be assigned. The evaluation will be based on the grading of assigned work, the use of rubrics in the project, and scoring two exams: a partial and a final.</td><td>Prerequisites:N3</td></tr>
<tr><td>Corequisites: CBM-208</td></tr>
<tr><td>Type of subject:
☒ Required
☐ Elective</td><td>Modality:
☒ In person class
☐ Blended learning
☐ Virtual</td><td>[Choose options:]
☐ Laboratory
☐ Internship or field practice
☐ Clinical rotations</td><td>Course programming component
☐ General Studies
☐ Specialized Studies
☒ Professional Studies</td></tr>
<tr><td colspan="4">Date of elaboration:
Date of last revision:</td></tr>
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Competencies	
Types of competencies	**Descriptions**
Conceptual competencies (A)	A1- Studies the fundamental concepts of the subject to analyze the statically determined structures. A2- Analyzes the relationship between loads, shear forces and bending moments to understand the diagrams of internal axial forces, shear forces and moments that occur in the structure elements. A3- Identifies the concepts behind the bars behavior to know the structures of trusses and use it in structural systems. A4- Understands the behavior of the influence lines for the analysis of mobile loads on the structures to design bridges and cranes. A5- Learns to determinate and use bending deformation using geometrical and energy methods. A6- Studies the fundamental concepts of the subject to analyze statically determined structures. A7-Analyzes flexibility and rigidity coefficients to generate the flexibility and rigidity matrix for the application of the Force Method and the Deformation Method in frames, beams and trusses. A8- Identifies the concepts of slope-deflection methods and moment-distribution method by Hardy Cross to solve hyperstatic structures. A9- Determines the behavior of the influence lines in hyperstatic structures for the analysis of mobile loads on structures. A10- Learns to determine and quantify the loads on the structures to perform their analysis of equilibrium.
Procedural competencies (B)	B1- Applies the learned concepts to demonstrate the behavior of statically determined structures in structural systems. B2- Uses the knowledge to apply internal axial forces, shear forces and moment diagrams in the design processes of these structures. B3- Tests the truss analysis processes to implement the use of this type of structure for its simplicity and constructive speed. B4- Executes the calculations and graphics of the influence lines for the simplification of the analysis of structures subjected to mobile loads. B5- Implements the knowledge of geometrical and energy methods in the calculations of the deformations to guarantee an adequate behavior of the structural systems. B6- Applies the learned concepts for the analysis of the statically indeterminate structures. B7- Uses the knowledge of flexibility and rigidity coefficients to assemble the flexibility and rigidity matrix in the Force and Deformation Methods. B8-Tests the processes of analysis of frames, beams and trusses, in the slope-deflection methods and moment-distribution method by Hardy Cross. B9- Executes the calculations and graphics of the influence lines for the simplification of the analysis of structures subjected to mobile loads. B10-Implements the knowledge and the quantification of the loads that act on the structures to solve them.
Attitudinal competencies (C)	C1- Validates the importance of internal forces diagrams (axial, shear and bending moment) to perform a structural design taking into account the fundamental aspects of safety, economy and functionality. C2- Understands people’s life quality improvement when performing the analysis that will produce designs of structures suitable for their use.

INC-309 THEORY OF STRUCTURES

Unit 1. Conceptual frame		
Contents	**Strategies and associated competences**	**Resources**
a) Structural applied forces b) Structural idealizations c) Types of supports and connections d) Conditions for equilibrium e) Hypothesis and fundamentals laws f) Structural stability g) Degree of static indeterminacy	Oral presentation, brainstorm (A1, B1, C1)	Whiteboard and marker, projector, virtual classroom

Required evidences	**Grade**	**Week**
Unit homework	1	1

Unit 2. Loads quantification		
Contents	**Strategies and associated competences**	**Resources**
a) Types of loads b) Gravity loads c) Wind loads d) Load transfers e) Familiarization with standards of the Public Works and Communication Ministry	Oral presentation, brainstorm, Project assignment,(A5, B5, C2, C3)	Whiteboard and marker, projector, virtual classroom

Required evidences	**Grade**	**Week**
Unit homework	1	1

Unit 3. Computation of forces at support and joints		
Contents	**Strategies and associated competences**	**Resources**
a) Nomenclature and calculus organization b) Force decomposition of sloped elements c) Concentration of distributed loads d) Free body diagram e) Equilibrium equations	Oral presentation, brainstorm (A1, B1, C1)	Whiteboard and marker, projector, virtual classroom

Required evidences	**Grade**	**Week**
Unit homework	1	2

Unit 4. Relationship between loads, shear and bending moment			
Contents	**Strategies and associated competences**	**Resources**	
a) Review of shear and bending moment diagrams b) System internal forces diagrams (M,N,V)	Oral presentation, brainstorm (A1, B1, C1)	Whiteboard and marker, projector, virtual classroom	
Required evidences		**Grade**	**Week**
Unit homework		2	2 & 3

Unit 5. Trusses analysis			
Contents	**Strategies and associated competences**	**Resources**	
a) Types, uses and classification of trusses b) Fundamentals concepts of bar's behavior c) Trusses applied forces d) Method of joints e) Method of sections f) Substitute element method	Oral presentation, brainstorm (A1, B1, C1)	Whiteboard and marker, projector, virtual classroom	
Required evidences		**Grade**	**Week**
Unit homework		1	3 & 4

Unit 6. Deflection computation			
Contents	**Strategies and associated competences**	**Resources**	
a) Direct integration method b) Conjugate beam method	Oral presentation, brainstorm (A1, B1, C1)	Whiteboard and marker, projector, virtual classroom	
Required evidences		**Grade**	**Week**
Unit homework		1	4 & 5

Unit 7. Energy methods		
Contents	**Strategies and associated competences**	**Resources**
a) Introduction b) Virtual work method c) Least work method (Castigliano's second theorem) d) Applications of Betti and Maxwell's Law	Oral presentation, brainstorm (A1, B1, C1)	Whiteboard and marker, projector, virtual classroom

Required evidences	**Grade**	**Week**
Unit homework, exam	1+30	5 & 6

Unit 8. Force method		
Contents	**Strategies and associated competences**	**Resources**
h) Flexibility coefficients i) Flexibility Matrix j) Consistent deformations equations k) Redundants l) Virtual Work m) Applications in beams, frames and trusses n) Flexible supports and support settlements	Oral presentation, brainstorm (A2, B2, C2)	Whiteboard and marker, projector, virtual classroom

Required evidences	**Grade**	**Week**
Unit homework	1	6 & 7

Unit 9. Influence lines		
Contents	**Strategies and associated competences**	**Resources**
a) Influence lines b) Introduction to the influence lines analysis c) Moving loads case d) Bridges e) Influence lines for statically indeterminate structures	Oral presentation, brainstorm (A4, B4, C2, C3)	Whiteboard and marker, projector, virtual classroom

Required evidences	**Grade**	**Week**
Unit homework	1	8

Unit 10. Moment distribution method			
Contents	**Strategies and associated competences**	**Resources**	
a) General approach b) Applications in structures with sideways c) Support settlement	Oral presentation, brainstorm (A3, B3, C2, C3)	Whiteboard and marker, projector, virtual classroom	
Required evidences		**Grade**	**Week**
Unit homework		1	9

Unit 11. Stiffness method			
Contents	**Strategies and associated competences**	**Resources**	
a) Stiffness coefficients b) Stiffness matrix c) Degree of kinematic indeterminacy d) Degree of freedom	Oral presentation, brainstorm, Project assignment, (A2, B2, C2)	Whiteboard and marker, projector, virtual classroom	
Required evidences		**Grade**	**Week**
Unit homework		2	10

Unit 12. Introduction to computer software analysis			
Contents	**Strategies and associated competences**	**Resources**	
a) Introduction to computer analysis of structures b) Structure modeling c) Structure analysis, results & interpretation	Oral presentation, brainstorm (A2, A3, A5, B2, B3, B5, C1, C2,C3)	Whiteboard and marker, projector, virtual classroom	
Required evidences		**Grade**	**Week**
Unit homework, Project presentation and final exam		1+20+30	11