General course information:

Course title:	Elastic Stability	**Course code:**	CE09_S04
Credits:	5	**Work load (hours):**	158
Course level:	Undergraduate ☒		Graduate ☐
Course type:	Mandatory ☐		Selective ☒
Course category:	Basic ☐		Orientation ☒
Semester:	8th	**Hours per week:**	4
Course objectives (capabilities pursued and learning results):			
Through this course all the required knowledge concerning the linearized static stability of structures is gained, with emphasis given on linear structures, which is the basis for further studies on the modern static as well as dynamic nonlinear stability and bifurcation theory.			
Prerequisites:			
Mathematics I, II, III Engineering Mechanics I, II, III Statics I, II, III			

Instructor's data:

Name:	Dimitrios Sophianopoulos
Level:	Assistant Professor
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Other tutors:	-

Specific course information:

Week No.	**Course contents**	**Hours**	
		Course attendance	**Preparation**
1	Introduction to the Linear Theory of Elastic Stability. Elastic Buckling – buckling mode, mild and violent buckling, stable, unstable and neutral equilibrium, buckling as an instability problem.	4	6
2	Flexural buckling of linear bars. General issues – basic assumptions, Sign convention, Moment – curvature relation, Buckling differential equation (beam under transverse loading and axial compression, beam under axial compression), Solutions of the buckling D.E., Load – displacement relation, Axial tension, Effect of axial loading, Buckling as an eigenvalue problem.	4	6
3	Effect of boundary conditions. General issues, Beams with ordinary supports – examples, Elastically supported axially compressed beam, buckling eigenmodes and mode shapes. Worked examples and exercises. The linear stability problem and its mathematical perspective, buckling as a Sturm-Liouville eigenvalue problem, Stability criterion – stability determinant, Orthogonality condition.	4	6

4	Buckling of simple structural elements. Gerber column partially fixed, orthogonal two-bar frame, Approximate methods (energy methods of Timoshenko and total potential energy, Rayleigh-Ritz method, Galerkin method), orthogonal symmetric three-bar frame, non orthogonal frames. Examples and exercises. The method of calculus of variations.	4	6
5	Simultaneous axial and bending action. General issues, column under transverse loading, superposition principle, fundamental bending moments, behavior of a column with imperfections (initial curvature, loading eccentricity), Effect of initial bending, Worked examples and exercises.	4	6
6	The effect of temperature. Simultaneous effect of temperature change and axial loading, Examples and exercises on the material taught during all previous weeks.	4	6
7	The generalized stiffness method. General issues, Fundamental relations, Orthogonal frame (sway and non-sway), triangular equally sided frame (symmetric and asymmetric buckling).	4	6
8	Exercises and worked examples on the material taught during the 7^{th} week.	4	6
9	Exercises and worked examples on the material taught during the 7^{th} week.	4	6
10	Torsional and lateral-torsional buckling of axially compressed beams. General issues, uniform (St. Venant) torsion, Nonuniform torsion – boundary conditions, Strain energy due to torsion, Torsional buckling – warping constant), Lateral – Torsional buckling (centre of twist, cross-sections with a single symmetry axis, potential energy due to combined bending and torsion)	4	6
Week No.	**Course contents**	**Hours**	
		Course attendance	**Preparation**
11	Exercises and worked examples on the material taught during the 10^{th} week.	4	6
12	Introduction to the principles of nonlinear theory of elastic stability. Equilibrium paths, critical points, energy theorems, stability and asymptotic stability, total potential and bifurcations, worked examples and discussion. Suggested further reading.	4	6
13	Example of a single degree of freedom system with distinct critical points.	4	6
14	Review examples and exercises.	4	6

Additional hours for:			
Class project	**Examinations**	**Preparation for examinations**	**Educational visit**
-	3	15	-

Suggested literature:

1. A.N. Kounadis : *Linear Theory of Elastic Stability* – 2^{nd} edition, Symeon Publishing, Athens 1997.
2. Z. P. Pazant, L. Cedolin : *Stability of Structures, Elastic, Inelastic and Damage Theories*, Oxford University Press, NY, 1991.
3. J. Chajes : *Principles of Structural Stability Theory*, Prentice-Hall, Englewood Cliffs, NJ, 1974.
4. St. P. Timoshenko, J. M. Gere : *Theory of Elastic Stability*, McGraw-Hill, NY, 1961.

Teaching method *(select and describe if necessary -* ***weight****):*		
Teaching	☒	40%
Seminars	☒	5%
Demonstrations	☒	5%
Laboratory	☐	……….%
Exercises	☒	50%
Visits at facilities	☐	……….%
Other *(describe):* ………………………..	☐	……….%
Total		100%

Evaluation method *(select)-* **weight:**				
	written	*%*	*Oral*	*%*
Homework	☐		☒	10
Class project	☐		☐	
Interim examination	☐		☐	
Final examinations	☒	80	☐	
Other *(describe):* Active class participation	☐		☒	10