(B) Course information in English

General course information:

Course title:	Structural Dynamics I	**Course code:**	ΓΚ4000
Credits:	6	**Work load (hours):**	153
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):

To develop an understanding of the behavior of structural systems subjected to general dynamic loading. Various methods of analysis will be presented for evaluating the time-dependent internal forces and deflections of dynamically loaded structures.
This course strengthens students' technical and intellectual competency, preparing them for engineering employment or advanced studies.
Furthermore, the class provides introduction and exposure to more advanced topics, stimulating student interest in life-long learning. Upon completion of the course, students should be able to demonstrate:

- Ability to formulate Equations of Motion for single and multiple degree of freedom systems and ability to calculate the free response of undamped and damped systems analytically.
- Ability to formulate Equations of Motion for single and multiple degree of forced systems and calculate the forced response of single-degree-of-freedom systems analytically using Duhamel's integral.
- Ability to solve the free vibration eigenvalue problem for a MDOF system. Understanding of the effect of damping in multi-degree-of-freedom systems and ability to utilize the Modal Superposition Method for calculating the response of MDOF systems under dynamic loading.
- Ability to utilize Equivalent Static Analysis Method and modal analyses techniques (Response Spectrum Analysis) to calculate the response of SDOF and MDOF structural systems respectively, to Seismic Excitations as required by the seismic codes.

Prerequisites:

Static Structural Analysis, and Matrix Structural Analysis
Linear Algebra (e.g., vectors, matrices, determinants).
Ordinary Differential Equations

Instructor's data:

Name:	**Konstantinos Tzaros**
Level:	**Dr. Civil Engineer, Adjunct Lecturer**
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Other tutors:	

Specific course information:

Week No.	**Course contents**	**Hours**	
		Course attendance	**Preparation**
1	➢ **Introduction to the Dynamics of Structures Inertia forces, dynamic loads and Second Newton's law. The D' Alembert's principle.** ➢ **Differential equation of motion for a beam in bending.** ➢ **Dynamic models of structural systems**	**4**	**6**
2	➢ **Equation of motion for Single Degree of Freedom systems (SDOF)** ➢ **Stiffness, damping and inertia in dynamic systems.** ➢ **Calculation of the lateral stiffness of framed structures. Static condensation.**	**4**	**6**
3	**Dynamic Response of SDOF.** ➢ **Free vibration of undamped systems.** ➢ **Frequency and period of a SDOF system.**	**4**	**6**
4	➢ **Viscously damped free vibration** ➢ **Undamped Forced Vibrations, Response to harmonic excitation**	**4**	**6**
5	➢ **Damped Forced Vibrations, Response to harmonic excitation.** ➢ **Forced vibrations for accidental loading.** ➢ **The Duhamel Integral.**	**4**	**6**
6	➢ **Periodic and aperiodic loading .** ➢ **Impulse Response .** ➢ **"Static" loading. Long and short duration loadings.**	**4**	**6**
7	**Seismic response of SDOF** ➢ **Ground motion.** ➢ **Equivalent seismic loads.**	**4**	**6**

	➢ **Elastic and inelastic spectrums.**		
8	➢ **Design spectrums.** ➢ **Design spectrums according to Greek codes and EC8.** ➢ **The equivalent lateral static method. Base shear and resultant design forces.**	**4**	**6**
9	**Dynamic Response of MDOF.** ➢ **Introduction to MDOF structural systems.** ➢ **Modelling MDOF structural systems.** ➢ **Stiffness matrix, mass matrix and damping matrix.**	**4**	**6**
10	➢ **Free vibration of MDOF systems. The dynamic eigenvalue problem.** ➢ **Dynamic properties. Eigen frequencies, eigen periods, eigen vectors, eigenmodes and normalized modes.**	**4**	**6**
11	➢ **Forced vibrations of MDOF structural systems.** ➢ **The Modal Superposition Method.**	**4**	**6**
12	**Seismic response of MDOF.** ➢ **Ground motion.** ➢ **Equations of motions for ground shaking.** ➢ **Equivalent seismic loads.**	**4**	**4**
13	➢ **Seismic codes according to Greek and European regulations.** ➢ **Equivalent lateral static method.**	**4**	**4**
14	➢ **Response spectrum method.**	**4**	**8**

Additional hours for:			
Class project	**Examinations**	**Preparation for examinations**	**Educational visit**
	3	6	

Suggested literature:

- Ι.Θ. Κατσικαδέλης «Δυναμική Ανάλυση των Κατασκευών Θεωρία και Εφαρμογές», Συμμετρία, 2012 (ISBN 978-960-266-352-3))
- Anil Chopra, *Dynamics of Structures*, Prentice Hall, 3rd Edition

Other Texts

Leonard Meirovitch, *Fundamentals of Vibrations*, McGraw Hill, 2001.
Clough, R. W. and Penzien, J., *Dynamics of Structures*, McGraw Hill, 2nd Edition, 1993.
D.J. Inman, *Engineering Vibration,* Prentice Hall, 1996.
Humar, J. , Dynamics of Structures, Taylor and Francis Ltd.3rd rev. Edition, 2012.
Greek seismic code EAK 2000.

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

Evaluation method *(select)*- **weight:**				
	written	*%*	*Oral*	*%*
Homework	☐		☐	
Class project	☐		☐	
Interim examination	☐		☐	
Final examinations	☑	100	☐	
Other *(describe):*……	☐		☐	