COURSE DESCRIPTION

1. GENERAL INFORMATION

SCHOOL	CIVIL ENGINEERING		
DEPARTMENT			
EDUCATION LEVEL	UNDERGRADUATE		
COURSE CODE	1075	**SEMESTER**	6
COURSE TITLE	STEEL STRUCTURES I		

COURSE UNITS *σε περίπτωση που οι διδακτικές απονέμονται σε διακριτά μέρη του μαθήματος π.χ. Διαλέξεις, Εργαστηριακές Ασκήσεις κ.λπ. Αν οι διδακτικές απονέμονται ενιαία για το σύνολο του μαθήματος αναγράψτε τις εβδομαδιαίες ώρες διδασκαλίας και το σύνολο των διδακτικών μονάδων / ECTS*	**HOURS**	**ECTS CREDITS**
	5	6
Προσθέστε σειρές αν χρειαστεί. Η οργάνωση διδασκαλίας και οι διδακτικές μέθοδοι που χρησιμοποιούνται περιγράφονται αναλυτικά στο 4.		

COURSE TYPE: *Γενικού Υποβάθρου, Ειδικού Υπόβαθρου, Ειδικότητας*	MANDATORY CORE COURSE
PREREQUISITE KNOWLEDGE:	
COURSE AND EXAMS LANGUAGE:	GREEK
COURSE OFFERED TO ERASMUS STUDENTS:	Yes, but attendance is difficult without at least some knowledge of the Greek language. The course is taught in Greek and the material on the course website is in Greek. Relevant English-language literature is recommended for Erasmus students. Examinations for Erasmus students are conducted in English, if requested.
COURSE WEBSITE (URL):	https://helios.ntua.gr/course/view.php?id=1561

2. LEARNING OBJECTIVES

Learning Objectives

Περιγράφονται τα μαθησιακά αποτελέσματα του μαθήματος οι συγκεκριμένες γνώσεις, δεξιότητες και ικανότητες καταλλήλου επιπέδου που θα αποκτήσουν οι φοιτητές μετά την επιτυχή ολοκλήρωση του μαθήματος.
Συμβουλευτείτε το Παράρτημα Α

- *Περιγραφή του Επιπέδου των Μαθησιακών Αποτελεσμάτων για κάθε ένα κύκλο σπουδών σύμφωνα με Πλαίσιο Προσόντων του Ευρωπαϊκού Χώρου Ανώτατης Εκπαίδευσης*
- *Περιγραφικοί Δείκτες Επιπέδων 6, 7 & 8 του Ευρωπαϊκού Πλαισίου Προσόντων Διά Βίου Μάθησης και Παράρτημα Β*
- *Περιληπτικός Οδηγός συγγραφής Μαθησιακών Αποτελεσμάτων*

After successfully attending the course, students:

- Will have acquired appropriate knowledge so that they:
  - Describe the advantages and disadvantages of steel as a construction material.
  - Recognize cases in which the choice of steel as a structural material is appropriate.
  - Combine basic principles of mechanics and statics from previous courses with knowledge of the Eurocodes for the design of steel structures that they will acquire in this course, in order to determine the actions and resistances of design of members and connections of steel structures.
- They will have acquired appropriate skills:
  - To understand the behavior of members and connections of steel structures.
  - To apply the above for the verification and dimensioning of members and connections of steel structures.
- They will have acquired appropriate competences so that they can:
  - Form the static system of simple metal structures.
  - Evaluate the advantages and disadvantages of alternative solutions.
  - Design simple steel structures.

General abilities

Λαμβάνοντας υπόψη τις γενικές ικανότητες που πρέπει να έχει αποκτήσει ο πτυχιούχος (όπως αυτές αναγράφονται στο Παράρτημα Διπλώματος και παρατίθενται ακολούθως) σε ποια / ποιες από αυτές αποσκοπεί το μάθημα;.

Αναζήτηση, ανάλυση και σύνθεση δεδομένων και πληροφοριών, με τη χρήση και των απαραίτητων τεχνολογιών
Προσαρμογή σε νέες καταστάσεις Λήψη αποφάσεων
Αυτόνομη εργασία Ομαδική εργασία
Εργασία σε διεθνές περιβάλλον
Εργασία σε διεπιστημονικό περιβάλλον
Παράγωγή νέων ερευνητικών ιδεών
Σχεδιασμός και διαχείριση έργων
Σεβασμός στη διαφορετικότητα και στην πολυπολιτισμικότητα Σεβασμός στο φυσικό περιβάλλον
Επίδειξη κοινωνικής, επαγγελματικής και ηθικής υπευθυνότητας και ευαισθησίας σε θέματα φύλου
Άσκηση κριτικής και αυτοκριτικής
Προαγωγή της ελεύθερης, δημιουργικής και επαγωγικής σκέψης

- Search, analysis and synthesis of data and information, using the necessary technologies
- Adaptation to new situations
- Decision making
- Autonomous work
- Teamwork
- Work in an international environment
- Work in an interdisciplinary environment
- Project planning and management
- Respect for the natural environment
- Demonstrating social, professional and ethical responsibility and sensitivity to gender issues
- Exercise criticism and self-criticism
- Promotion of free, creative and inductive thinking

3. COURSE DESCRIPTION

Introduction

Objectives and organization of the course, work phases of a structural engineer in steel structures, types of structural steel works, production methods of structural steel, hot rolling, standard cross-sections, cross-section shapes, tables of standard cross-sections, cold rolling, thin-walled cross-sections, steel sheets, built-up cross-sections, steel project implementation stages, manufacturing, construction, mechanical properties of steel, steel grades, comparison of construction materials, advantages-disadvantages of steel, the role of regulations, Eurocodes and EC3, failure and serviceability limit states, actions and resistances, partial load factors and material factors, loads, combinations of loads.

Members in tension

Examples from practice, mechanical behavior, full section yield strength, reduced section fracture strength, EC3 ultimate strength, ductility criterion, zigzag bolts, critical reduced section, eccentrically connected members. Application examples.

Simple bolted and welded connections

Examples from practice, types of connections in steel structures, advantages and disadvantages of bolting/welding, selection of a suitable method of connection based on the criteria of the place of execution and the possibilities of transportation and erection, geometry of bolts, bolt grades, distance limits, mechanical behavior of simple shear bolts, bolt shear resistance, bearing resistance, single and multiple shear planes, bolts in tension, bolts in shear and tension, EC3 provisions, long-length boltings, ductility criterion, welding technology, types of welds (fillet welds – full/partial penetration butt welds), welding errors, quality checks of welds, resistance calculation, EC3 provisions, long-length welds. Application examples.

Members under axial compression

Examples from practice, mechanical behavior, possible failure mechanisms (yielding, flexural buckling, local buckling), necessity to formulate equations in the deformed geometry, flexural buckling differential equation, critical buckling loads, buckling modes, concept of lateral support, interaction of yielding and

buckling, influence of initial imperfections, buckling curves, resistance of compression member according to EC3, buckling about strong and weak axis, local buckling, classification of cross sections of compression members into categories, influence of boundary conditions, equivalent buckling length, buckling of columns in frames. Application examples.

Laterally protected members under transverse loads

Practical examples, mechanical behavior, bending and shear, concepts of moment of inertia, elastic moment of resistance and shear surface, advantageous cross-sectional shapes and proper orientation, elastic verification, bending/shear interaction, von Mises equivalent stresses, serviceability checks, elastoplastic behavior of a member under transverse loads, plastic verification, EC3 provisions, local buckling of flexural members and EC3 classification of cross-sections. Application examples.

Torsion and warping

Examples from practice, shear center of cross-sections, ways of dealing with torsion, mechanical behavior of a circular cross-section bar under torsion, torsional constant, behavior of closed sections, pure torsion or St. Venant torsion, behavior of open sections, warping, stress due to warping, torsion/ warping differential equation, EC3 provisions. Application examples.

Laterally unprotected members under transverse loads

Concept and mechanism of lateral buckling, behavior of closed and open sections, differential equation of lateral buckling, elastic critical lateral buckling moment, influence of shape of bending moment diagram, location of load application and boundary conditions, EC3 provisions, lateral constraints. Application examples.

Cross-sections under combined actions

Examples from practice, types of stresses produced by each action effect, superposition of stresses and elastic interaction, plastic interaction of axial force, shear forces and bending moments for various cross-sectional shapes, interaction diagrams, EC3 provisions. Application examples.

Members under combined actions

Examples from practice, possible failure modes of members under axial compression and bending moment (yielding, flexural buckling about strong/weak axis, local buckling, torsional-flexural buckling), interaction of axial compression and bending moment, differential equation of equilibrium, elastic interaction coefficient, EC3 provisions. Application examples.

Standard single-storey steel hangars

Examples from practice, geometry, main structural members (main frames, bracings, purlins, head-beams, end columns) and their role, load-carrying mechanisms, common cross-sections and their orientation, typical connections. Application examples.

4. TEACHING METHODS – STUDENT ASSESSMENT

TEACHING METHODS: *Πρόσωπο με πρόσωπο, Εξ αποστάσεως εκπαίδευση κ.λπ.*	The course is delivered face-to-face, with a continuous flow of theory and applications, using projected PowerPoint presentations as well as using a traditional chalkboard.	
TEACHING MEDIA: *Χρήση Τ.Π.Ε. στη Διδασκαλία, στην Εργαστηριακή Εκπαίδευση, στην Επικοινωνία με τους φοιτητές*	PowerPoint presentations are used. All course material is posted on the course website. Included are PowerPoint presentations, course teaching notes, articles from international literature and past exam papers. Teachers communicate with students via e-mail sent to all registered students via the course website. Communication with individual students for guidance and resolution of questions regarding the course or their individual term projects is also done via e-mail.	
COURSE ARRANGEMENT: *Περιγράφονται αναλυτικά ο τρόπος και μέθοδοι διδασκαλίας.*	***ACTIVITY***	***IMPORTANCE***
Διαλέξεις, Σεμινάρια, Εργαστηριακή Άσκηση, Άσκηση Πεδίου, Μελέτη & ανάλυση βιβλιογραφίας, Φροντιστήριο, Πρακτική (Τοποθέτηση), Κλινική Άσκηση, Καλλιτεχνικό Εργαστήριο, Διαδραστική	Lectures	3 x 13 = 39

διδασκαλία, Εκπαιδευτικές επισκέψεις, Εκπόνηση μελέτης (project), Συγγραφή εργασίας / εργασιών, Καλλιτεχνική δημιουργία, κ.λπ. *Αναγράφονται οι ώρες μελέτης του φοιτητή για κάθε μαθησιακή δραστηριότητα καθώς και οι ώρες μη καθοδηγούμενης μελέτης ώστε ο συνολικός φόρτος εργασίας σε επίπεδο εξαμήνου να αντιστοιχεί στα standards του ECTS*	Exercises and applications	2 x 13 = 26
	Voluntary laboratory exercises	0
	Home study	85
	OVERALL:	**150**
STUDENT ASSESSMENT: *Περιγραφή της διαδικασίας αξιολόγησης* *Γλώσσα Αξιολόγησης, Μέθοδοι αξιολόγησης, Διαμορφωτική ή Συμπερασματική, Δοκιμασία Πολλαπλής Επιλογής, Ερωτήσεις Σύντομης Απάντησης, Ερωτήσεις Ανάπτυξης Δοκιμίων, Επίλυση Προβλημάτων, Γραπτή Εργασία, Έκθεση / Αναφορά, Προφορική Εξέταση, Δημόσια Παρουσίαση, Εργαστηριακή Εργασία, Κλινική Εξέταση Ασθενούς, Καλλιτεχνική Ερμηνεία, Άλλη / Άλλες* *Αναφέρονται ρητά προσδιορισμένα κριτήρια αξιολόγησης και εάν και που είναι προσβάσιμα από τους φοιτητές.*	The evaluation language is Greek. Examinations for Erasmus students are conducted in English, if requested. The examination procedures include a preliminary examination (around the 8th week of the course) and a final examination. Both the preliminary and final exams include problem-solving and short qualitative questions. The final grade of the course, with a maximum of 10, is calculated as follows: a) If the grade of the final exam is below 4.0, this is also the overall grade b) If the final exam grade is 4.0 or higher, then the total grade is the maximum of the following i) 100% of the final exam grade ii) 30% of the preliminary exam grade + 70% of the final exam grade These criteria are listed on the course website.	

5. TEXTBOOKS – BIBLIOGRAPHY

- *Suggested Bibliography:*

I. Vagias, I. Ermopoulos, G. Ioannidis, "Design of structural steel works with application examples", 2013.

I. Vagias, X. Gantes, I. Ermopoulos, G. Ioannidis, "Examples of application in special issues of metal constructions", 2013.

- *Related scientific journals:*

Journal of Constructional Steel Research, International Journal of Steel Structures, Engineering Structures, Structures, Thin-Walled Structures, A.S.C.E. Journal of Structural Engineering, A.S.C.E. Journal of Engineering Mechanics, Structural Engineering and Mechanics, Structure and Infrastructure Engineering, Structural Engineering International, International Journal of Space Structures, Journal of the International Association for Shell and Spatial Structures, Computers & Structures, Soil Dynamics and Earthquake Engineering, Earthquake Engineering and Structural Dynamics.