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Institute of Airports
Computer Technologies of Construction Department

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Quality Management System

COURSE TRAINING PROGRAM

on

Structural Mechanics
(according to ECTS)

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Major: 6.060101 "Civil Engineering"

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Self-study – 57

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*Independent thoughts arise only from
self-acquired knowledge.*

K.D. Ushinsky

INTRODUCTION

Detailed course training program of the subject is a must for successful educational process according to the European Credit Transfer System. Teachers and students are to be familiarized with it.

Grading system of assessment (GSA) is an integral part of the work course training program providing assessment the quality of all kinds of auditorium educational work and self-study performed by a student, as well as acquired knowledge and skills through grading assessment of results of this work in the current, modular and semester control with transfer of the grades by multi-grade scale to the national grading scale and ECTS scale.

1. EXPLANATORY NOTES

1.1. Subject status in the system of professional training

The subject is the theoretical and practical base of knowledge and skills which are formed the future civil engineer in area of airport construction. The course is the theoretical foundation for body of knowledge and skills needed to design constructions in the sphere of civil engineering.

1.2. Target of the subject

Aim for mastering the subject is to introduce with the methods and standards of airport construction, develop abilities for applying in practice, and organize activities on the enterprise or organization.

1.3. Objectives to study the subject

The tasks of mastering the subject are the following:

- unassisted to use methods for statically determinate framed structures analysis;
- unassisted to use the theoretical principles of framed structures analysis;
- unassisted to use terms and methods that are used for analytical models creation of structures.

1.4. Integrated requirements for knowledge and skills of the subject (educational module)

As a result of mastering the subject a student shall:

Know:

- principles and methods for building constructions analysis;
- the State norms that are used for structural mechanics tasks;
- main directions of structural mechanics development;
- approaches of structural mechanics task solutions using;



Learning outcomes:

- to perform structural mechanics tasks;
- to evaluate structural performance of structures and their elements;
- to use correctly structural mechanics methods for structures analysis;
- to use software that is used structural mechanics methods.

1.5. Integrated requirements for learning outcomes in educational modules

The instructional material of the subject is divided into four modules.

1.5.1. As a result of studying the material of the module №1 "The analysis of statically determinate structures subjected to stationary loads" student shall:

Know:

- main principles основні принципи та етапи аналізу розрахункових схем стержневих систем;
- main principles and hypotheses of internal force diagrams construction;
- main principles of analytical model construction for any structure;

Learning outcomes:

- to perform geometric construction analysis of structures;
- to determine internal forces for any point of framed structure;
- to determine internal forces for arches.

1.5.2. As a result of studying the material of the module №2 "Computing displacements and analysis of statically determinate structures subjected to moving loads" student shall:

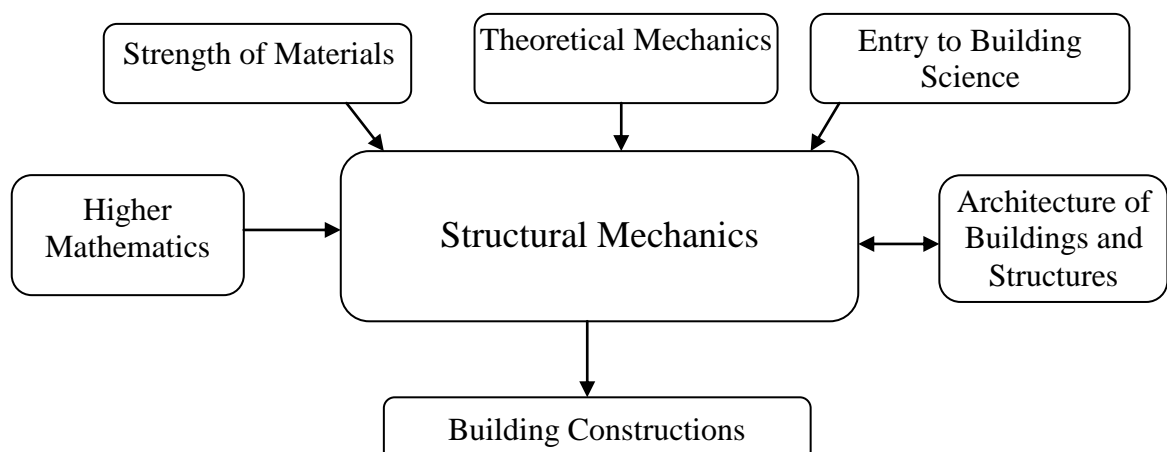
Know:

- main terms and theorems for computing deflection in any point of framed structure that is under action of stationary load;
- principles of framed structures analysis subjected to moving loads.

Learning outcomes:

- to determine deflections from any impact and in any point of framed structure;
- to construct influence lines for internal forces of framed structures.

1.6. Interdisciplinary links of the subject





2. SUBJECT CONTENT

2.1. Training schedule of the subject


№	Topic	Academic Hours			
		All	Lectures	Practicals	Self-study
1	2	3	4	5	6
5th Semester					
Module №1 „The analysis of statically determinate structures subjected to stationary loads”					
1.1	Structural mechanics, its tasks and methods. The concept of degrees of freedom. Geometric construction analysis of structures. Geometrically stable system.	10	2	4	4
1.2	Determination of frame internal forces by using the method of sections. Determination of internal forces of frame member ends.	10	2	4	4
1.3.	Truss analysis.	12	2	4	6
1.4	Analysis of statically determinate multispans beams and arches.	15	2	6	7
1.5	Computing and Schematic Paper №1	10	–	–	10
1.6	Module Test №1	3	–	2	1
Total for the module №1		60	8	20	32
Module №2 "Computing displacements and analysis of statically determinate structures subjected to moving loads"					
2.1	Calculation of displacements for framed structures.	11	2	4	5
2.2	Influence lines. Analysis of statically determinate multispans beams subjected to variable loads.	10	2	4	4
2.3	Influence lines for trusses.	6	2	2	2
2.4	Influence lines for three-hinged arches.	8	3	2	3
2.5	Computing and Schematic Paper №2	10	–	–	10
2.6	Module Test №2	3	–	2	1
Total for the module №2		48	9	14	25
Total for 5th semester		108	17	34	57



2.2. Development of the didactic process for different types of classes

2.2.1. Lectures, their subject matters and planned hours

№	Topic	Academic Hours	
		Lectures	Self-study
1	2	3	4
5th Semester			
Module №1 „The analysis of statically determinate structures subjected to stationary loads”			
1.1	Structural mechanics, its tasks and methods. Statically determinate structures classification. Analytical models of structures, types of joints, types of supports, loads classification. The concept of degrees of freedom. Geometric construction analysis of structures. Geometrically stable system. Geometrically unstable system. Step-by-step geometric construction analysis of framed structure procedure.	2	1
1.2	Classification of framed structures. Plane statically determinate rigid frames. Types of rigid frames. Rigid frame analysis. Main methods for simple frame analysis.	2	1
1.3	Geometric construction analysis of rigid frames. The analyzing of reactions for statically determinate rigid frames. Determination of internal forces by using the method of sections. Plane statically determinate trusses. Trusses at airport construction. Truss analysis. The methods of joints. The method of sections. Statically determinate multispans beams. Statically determinate multispans beam analysis.	2	2
1.4	Statically determinate multispans beam analysis. Three hinged arches. Types of three hinged arches. Three hinged arch analysis. Composite structure and methods for its analysis.	2	2
Total for the module №1		8	6
Module №2 "Computing displacements and analysis of statically determinate structures subjected to moving loads"			
2.1	Introduction for calculation of structural displacement. General equation and unit load method for computing displacements. Graph-multiplication method. Calculation of displacements caused by loads. Calculation of displacements for rigid frames, beams, trusses, arches and composite structures. Calculation of displacements caused by temperature changes and support movement.	2	1
2.2	Concept of influence lines. Influence lines of internal forces (support reactions, bending moments and shear forces) for simple beam. Influence lines of internal forces for cantilever beam. Matrix method for variable loads analysis. Analysis of statically determinate multispans beams subjected to variable loads.	2	1

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1	2	3	4
2.3	Influence lines for trusses. Influence lines for axial forces of truss members.	2	1
2.4	Influence lines for three-hinged arches. Influence lines of arch thrust and internal forces for three-hinged arches. Application of influence lines. Beams, trusses and arches subjected to live and moving loads. The most unfavorable arrangement of a series of moving concentrated loads. Determination of the maximum positive (negative) value of internal forces.	3	2
Total for the module № 2		9	5
Total for 5th semester		17	11
Total for the subject		17	11

2.2.2. Practicals, their subject matters and planned hours

№	Topic	Academic Hours	
		Practicals	Self-study
1	2	3	4
5th Semester			
Module №1 „The analysis of statically determinate structures subjected to stationary loads”			
1.1	Analytical models of structures, types of joints, types of supports, loads classification.	2	2
1.2	Degrees of freedom. Geometric construction analysis of structures. Geometrically stable system. Geometrically unstable system.	2	1
1.3	Determination of frame internal forces by using the method of sections. Determination of internal forces of frame member ends.	2	2
1.4	Construction of internal force diagrams of statically determinate frames.	2	1
1.5	Step-by-step statically determinate frame analysis procedure.	2	2
1.6	Determination of internal forces of trusses.	2	2
1.7	Determination of internal forces of thrust trusses	2	2
1.8	Construction of internal force diagrams of statically determinate multi-span beams. Examples of bending moment and shear force diagrams of statically determinate multi-span beams	2	1
1.9	Determination of internal forces of three-hinged hangar arches. Construction of internal force diagrams of arches.	2	2
1.10	Module Test №1	2	1
Total for the module №1		20	16
Module №2 "Computing displacements and analysis of statically determinate structures subjected to moving loads"			
2.1	General equation and unit load method for computing displacements. Graph-multiplication method. Calculation of displacements caused by loads.	2	2
2.2	Calculation of displacements for rigid frames, beams, trusses, arches and composite structures	2	2



1	2	3	4
2.3	Calculation of displacements caused by temperature changes and support movement	2	2
2.4	Beams, trusses and arches subjected to live and moving loads.	2	1
2.5	Influence lines for axial forces of truss members.	2	1
2.6	Influence lines for three-hinged arches and composite structures.	2	1
2.7	Module Test №2	2	1
Total for the module № 2		14	10
Total for 5th semester		34	26
Total for the subject		34	26

2.2.3. Student self-study, its content and planned hours

№	Self-study Content	Academic Hours
5th Semester		
1.	Lecture study	11
2.	Training of Laboratory Classes	24
3.	Computing and schematic paper №1 and №2 carrying out	20
4.	Training of Module Tests	2
Total for 5th semester		57
Total for the subject		57

2.2.3.1. Computing and Schematic Paper

Computing and schematic paper is carried out in the 5th semester according to the approved methodical guide for fastening and deepening of theoretical knowledge and skills received by the student in the course of subject material.

Computing and schematic paper №1 is carried out on the basis of self-study instructional material and is the constituent of the module №1 "The analysis of statically determinate structures subjected to stationary loadings".

Computing and schematic paper №1 purpose depends on the task variant and is contained in analysis of statically determinate structures subjected to stationary loads: geometric construction analysis of structure, determination of support reactions and internal forces, construction of internal force diagrams.

Carrying out and defending the computing and schematic paper №1 is realized by student individually according to the methodological guide.

Time required for carrying out the computing and schematic paper №1 performance is equal up to 10 academic hours of self-study.

Computing and schematic paper №2 is carried out on the basis of self-study instructional material and is the constituent of the module №2 "Computing displacements and analysis of statically determinate structures subjected to variable loads".

Computing and schematic paper №2 purpose depends on the task variant and is contained in analysis of statically determinate structures subjected to moving loads: calculation of displacements caused by loads, calculation of displacements caused by temperature changes and support movement and influence line construction for any internal force.



Carrying out and defending the computing and schematic paper №2 is realized by student individually according to the methodological guide.

Time required for carrying out the computing and schematic paper №2 performance is equal up to 10 academic hours of self-study.

3. BASIC CONCEPTS OF GUIDANCE ON THE SUBJECT

3.1. List of references

Basic literature

3.1.1. Дарков А.В. Шапошников И.Н. Дарков А.В. Шапошников И.Н. Строительная механика– М.: Стройиздат, 1981 – 512 с.

3.1.2. Верюжский Ю.В., Волков В.И., Синев П.А. Строительная механика. Методические указания по расчету статически определимых систем на подвижную нагрузку. —К.: КИИГА, 1991.–52с.

3.1.3. Верюжський Ю.В., та ін. Будівельна механіка. Розрахунок статично визначуваних стержневих систем. К.: НАУ, 2009. 198с.

3.1.4. Верюжский Ю.В., Волков В.И., Синев П.А., Сисенгалиев М.К. Строительная механика. Методические указания по расчету статически определимых систем на неподвижную нагрузку с использованием вычислительной техники .– К.: КИИГА, 1990. –76с.

Additional literature

3.1.5. Саргсян А.Е. Строительная механика. Основы теории с примерами расчетов – К.: КИИГА, 2000. –346 с.

3.2. List of basic guidance materials for the subject

№	Name	Index of Topics where Guides are Used	Amount
1	2	3	4
1.	Methodical guide to carrying out computing and schematic papers	1.11.4, 2.12.4	32 copies



4. RATING SYSTEM OF KNOWLEDGE AND SKILLS ASSESSMENT

4.1 Basic terms and definitions

4.1.1. Semester Graded Test is a form of final check of how well a student has mastered both theoretical and practical material in a given subject during a semester. Written examination is held during the examination period in the presence of a board of examiners headed by the chief of the department in accordance with the established time-table.

To maintain objectivity of evaluation and clarity of control over the knowledge and skills acquired by students the terminal examination is held at the university in written form or with application of computer technology. The given rule does not refer to the courses which require mostly verbal answers from students. The list of courses with verbal (combined) form of terminal examination is drawn up according to each branch (specialty) of study upon the authorization of the Deputy Rector for Academics.

4.1.2. ECTS system is a model of academic process organization based on a combination of two constituents: module technology of training and credits (Test Units) and covers the content, forms and facilities of academic process, forms of checking students' knowledge and skills quality as well as academic activity of students both in class and outside it (i.e. self-study). The ECTS system aims at making students work on a systematic basis during the semester in view of their future professional success.

4.1.3. A module is a logically complete, relatively independent integral part of a training course, a set of theoretical and practical tasks of relevant content and structure with an elaborated system of methodical, educative, individual and technological support, a necessary component of which is an appropriate form of grading.

4.1.4. A credit (test unit) is a single unit of measuring work done by students both in class and outside it (Academic Load) which is equivalent to 36 working hours.

4.1.5. A grade is a quantitative measuring unit of students' learning outcomes assessment, based on a multi-value scale as they perform their pre-assigned set of academic tasks.

4.1.6. The ECTS grading system is a system of measuring the quality of all types of classroom and self-study work done by students as well as the level of their knowledge and skills by assessing them in values according to the 100-value scale with further transfer of these values into the national scale and the ECTS scale.

The grading system envisages the use of the following grades: the current module grade, the module test grade, the total module grade, the semester module grade, the examination grade and the total semester grade.

4.1.6.1. The current module grade consists of values which a student gets for a certain kind of academic work in mastering a given module, i.e. doing and de-



fending his/her individual tasks at practical classes.

4.1.6.2. The module test grade is determined in values and in national scale grades as a result of doing the module test.

4.1.6.3. The total module grade is determined in values and in national scale grades as the sum of the current module grade and test module grade.

4.1.6.4. The semester module grade is determined in values and in national scale grades as the sum of the total module grades obtained after studying the material of all the modules within a semester.

4.1.6.5. The graded test grade is determined in values and in national scale grades in the result of carrying out the examination tasks.

4.1.6.6. The total semester grade is determined as the sum of the semester module grade and the examination/differentiated test grade in values, national scale grades and ECTS scale grades.

4.2. Methods of the knowledge and skills assessment rating system

4.2.1. Grading of different kinds of academic activities performed by a student and obtained knowledge and skills are realized in values in line with Table 4.1.

Table 4.1

Grading of different kinds of academic activities performed by a student

Module №1		Module №2	
Kind of Academic Activities	Max Grade	Kind of Academic Activities	Max Grade
Carrying out and Defending the Practical №1.1 and 1.2	5	Carrying out and Defending the Practical №2.1 and №2.2	5
Carrying out and Defending the Practical №1.3 and №1.4	5	Carrying out and Defending the Practical №2.3 and №2.4	5
Carrying out and Defending the Practical №1.5	5	Carrying out and Defending the Practical №2.5	5
Carrying out and Defending the Practical №1.6 and №1.7	5	Carrying out and Defending the Practical №2.6	5
Carrying out and Defending the Practical №1.8 and №1.9	5	Carrying out and Defending the Computing and Schematic Paper №2	7
Carrying out and Defending the Computing and Schematic Paper №1	8	<i>For carrying out module test №2, a student must receive not less than 16 values</i>	
<i>For carrying out module test №1, a student must receive not less than 20 values</i>			
Module Test №1	13	Module Test №2	15
Total for module №1	46	Total for module №2	42
Semester Examination			12
Total Semester Grade			100

4.2.2. The completed curricular activity is accounted if the student received a positive mark according to the national scale given in Table 4.2 below.

Table 4.2

Correspondence between the Grades and the National Scale

Рейтингова оцінка в балах					National Scale
Carrying out and Defending the Practical	Carrying out and Defending the Computing and Schematic Paper №1	Carrying out and Defending the Computing and Schematic Paper № 2	Module Test №1	Module Test № 2	
5	8	7	12-13	14-15	Excellent
4	6-7	6	10-11	11-13	Good
3	5	4-5	8-9	9-10	Satisfactory
under 3	under 5	under 4	under 8	under 9	Bad

4.2.3. The grades a student has been given for the different kinds of academic work are summed up and the result constituting a Current Module Grade is entered into the Module Grade Register.

4.2.4. If a student has successfully done all kinds of academic work within the given module and has got a positive Current Module Grade according to the national scale, he/she is allowed to take his/her module test.

4.2.5. The procedure of module testing, which lasts up to two academic hours, is held by a commission headed by the head of the department responsible for the discipline.

4.2.6. The Current Module Grade and the Module Test Grade together make up a Total Module Grade whose correspondence to the National Scale is shown in Table 4.3.

Table 4.3

Correspondence between the Total Module Grades and the National Scale

Module №1	Module №2	National Scale
41-46	38-42	Excellent
35-40	32-37	Good
28-34	25-31	Satisfactory
under 28	under 25	Bad

4.2.7. A student is considered to have passed the module if both his/her Current Module Grade and Module Test Grade are positive, i.e. higher than «bad» according to the national scale (Tables 4.2), which yields a positive Total Module Grade (Table 4.3).

4.2.8. If a student has missed the module test due to any reason (being ill, debarred, etc.), the entry «absent» is made against his/her name in the column «Module Test Grade» and the entry «unclassified» - in the column «Total Module Grade».



The student is considered as not having an academic incomplete if he/she is allowed to take his/her module test but has missed it due to a valid reason. Otherwise he/she is considered as having an academic incomplete.

Further testing the student in this module is done in accordance with the established procedure.

In case if student received negative module test rating mark, he has a chance to retake the test according to the established procedure.

4.2.10. In case of retaking the module test, the maximum module grades equals 11 («Good» mark according to the national scale), i.e. it is two points less than that given in table 4.2.

4.2.11. A student is not allowed to increase his/her positive Total Module Grade by taking a repetitive test.

4.2.12. The Semester Module Grade is calculated as the sum of the Total Module Grades. The correspondence between Semester Module Grade values and the National Scale is given in Table 4.4 and Table 4.5.

Table 4.4
Correspondence between the Semester Module Grades and the National Scale

Semester Grades	National Scale
79-88	Excellent
66-78	Good
53-65	Satisfactory
under 53	Bad

Table 4.5
Correspondence between the Examination Grade and the National Scale

Examination Grades	National Scale
11-12	Excellent
9-10	Good
7-8	Satisfactory
under 7	Bad

4.2.13. A student having positive (higher than 'bad' according to the national scale) Semester Module Grade is allowed to take a semester exam, foreseen by the curriculum from the subject in the 5th semester.

4.2.14. Students have their semester exam in a written form. The procedure, which lasts up to three academic hours, is held by a commission headed by the head of the department.

4.2.15. A student who has got a positive (higher than 'bad' according to the national scale) examination grade (Table 4.5) is considered to have passed the semester course in this discipline. Otherwise the student is to be re-examined in accordance with the established procedure.

4.2.16. During repeated passing of Semester Exam the maximal Examination Grade, which can be got by a student equals 10 ("Good" according to the national scale), i.e. the grade value presented in Table 4.5 is reduced by 2.

4.2.17. The Semester Module Grade and the Examination Grade together make up a Total Semester Grade whose correspondence to the National Scale and the ECTS Scale is shown in Table 4.6.



Table 4.6

Correspondence of the Total Semester Grades to the National Scale
and the ECTS System

Total Semester Grades	National Scale	ECTS System	
		ECTS Grade	Explanation
90-100	Excellent	A	Excellent (excellent performance with insignificant shortcomings)
82 – 89	Good	B	Very Good (performance above the average standard with few mistakes)
75 – 81		C	Good (good performance altogether with a certain number of significant mistakes)
67 – 74	Satisfactory	D	Satisfactory (performance meets the average standards)
60 – 66		E	Sufficient (performance meets the minimal criteria)
35 – 59	Bad	FX	Bad (bad performance; a second testing is required)
1 – 34		F	Bad (very bad performance; a student shall retake the course)

4.2.18. A student has the right to get his/her Total Semester Grade without taking a semester exam if, throughout the whole semester, he/she has done all the kinds of academic work in time and has got a positive (higher than ‘bad’ according to the national scale) Semester Module Grade. Otherwise he must pass the semester exam.

4.2.10. To be allowed not to take the exam, a student shall submit a written application to the Dean of the Faculty.

4.2.20. A student who, throughout the whole semester, has done all the kinds of academic work in time (without delays) and without repetitive module tests, has got a positive (higher than ‘bad’ according to the national scale) Semester Module Grade, and has decided not to take the exam gets his/her Total Semester Grade as the sum of his/her Semester Module Grade and the minimal Examination Grade established for each category of Semester Module Grades (*11 for “Excellent”, 9 for “Good, and 7 for “Satisfactory”*).

4.2.21. If a student who was obliged to take an exam has missed it due to any reason (being ill, debarred, etc.), the entry ‘absent’ is made against his/her name in the column ‘Examination Grade’ and the entry ‘unclassified’ – in the column ‘Total Semester Grade’.



In this case the student is considered as not having an academic incomplete if he/she is allowed to take his/her exam but has missed it due to a valid reason. Otherwise he/she is considered as having an academic incomplete.

Further testing the student in this module is done in accordance with the established procedure.

4.2.22. A student is not allowed to increase his/her positive Total Semester Grade by taking a repetitive semester examination.

4.2.23. The Total Semester Grade is entered into the Examination Register and into a student's record book in values, National Scale grades, and ECTS Scale grades.

4.2.24. The Total Semester Grade is entered into a student's record book, for example: **92/Ex/A**, **87/Good/B**, **79/Good/C**, **68/Sat/D**, **65/Sat/E**, etc.

