

NATIONAL AVIATION UNIVERSITY  
Aerospace Institute  
Mechanical Power Faculty  
Engineering department

“AGREED”

Acting Director of  
the Aerospace Institute

\_\_\_\_\_ V.Shmarov  
“ 3 ” \_\_\_\_\_ 02 \_\_\_\_\_ 2012

“APPROVED”

Deputy Rector for Academics

\_\_\_\_\_ A.Polukhin  
“ 17 ” \_\_\_\_\_ 02 \_\_\_\_\_ 2012



Quality Management System

**CURRICULUM**  
of the discipline  
**“Metrology and standardization”**  
(according to ECTS)


Field of Study: 0701 "Transport and Transport Infrastructure"  
Major: 6.070103 "Aircraft Maintenance"

Year of study – 3  
Lectures – 17  
Laboratory classes – 17  
Student's self-study hours – 20  
Total (hours/ECTS credits) – 54/1.5

Semester – 5  
Graded test – 5<sup>th</sup> semester

Index P1-6.070103-1a/11-3.1.6  
P1-6.070103-1a/11-3.1.6

**QMS NAU CUR 07.01.02-01-2012**

	Quality Management System. Curriculum of the discipline "Metrology and standardization"	Document code	QMS NAU CUR 07.01.02-01-2012
		Page 2	

The curriculum is based on the «Metrology and standardization» syllabus index H1–6.070103–1/11–3.1.6 and H1–6.070103–2/11–3.1.6 approved \_5\_.10\_.2011, and Bachelor Curriculum № ПБ-1-6.070103-1-a/11 and № ПБ-1-6.070103-2-a/11 for major 6.070103 “Aircraft Maintenance”, “Provisional Regulations on the Organization of the Academic process according to ECTS (within the pedagogical experiment)” and “Provisional Regulations on the Rating Assessment system” approved by the Rector of the University (order № 122/од of 15.06.2004, order №81/од of 12.04.2005).

Developed by

Ph D, Assistant professor \_\_\_\_\_ O. Bashta  
Engineering Department

Ph D, Professor of \_\_\_\_\_ R. Mnatsakanov  
the Engineering Department

Considered and approved by the Engineering Department, Minutes № \_ of \_\_\_\_\_2011.

Head of the department \_\_\_\_\_ M. Kindrachuk

Considered and approved by the Degree-Granting Departments for the major 6.070103 “Aircraft Maintenance” (specialty 7/8.07010301 “Maintenance and repair of aircraft and engines”) – department of Aviation Equipment Continued Airworthiness, Minutes № \_\_\_ of \_\_\_\_\_ 2011.

Head of the Department \_\_\_\_\_ S. Dmitriev

Considered and approved by the Degree-Granting Departments for the major 6.070103 “Aircraft Maintenance” (specialty 7/8.07010303 “Airport technologies and equipment”) – Airport Technologies department, Minutes № \_\_\_ of \_\_\_\_\_ 2011.

Head of the Department \_\_\_\_\_ O. Tamargazin

Considered and approved by the Scientific-Methodological-Editorial Board of the Airspace Institute, Minutes № \_\_\_ of \_\_\_\_\_ 2011.

Head of the SMEB \_\_\_\_\_ V. Kravtsov

“Agreed”

Dean of the Mechanical  
Power Faculty  
\_\_\_\_\_ O. Samkov

“ \_\_\_ ” \_\_\_\_\_ 2011

“Agreed”


Acting Director of  
the Airspace Institute  
\_\_\_\_\_ V. Shmarov

“ \_\_\_ ” \_\_\_\_\_ 2011

Document level – 3b


Routine inspecting – annually

**Master copy**

	Quality Management System. Curriculum of the discipline "Metrology and standardization"	Document code	QMS NAU CUR 07.01.02-01-2012
		Page 3	

## Contents

<b>Introduction</b> .....	4
<b>1. Reference notes</b> .....	4
1.1. Discipline status in the system of professional training .....	4
1.2. Aim of the discipline .....	4
1.3. Tasks for learning the discipline.....	4
1.4. Integrated requirements for learning outcomes on the discipline.....	4
1.5. Integrated requirements for learning outcomes on modules .....	4
1.6. Interconnection with other disciplines .....	5
<b>2. Discipline content</b> .....	6
2.1. Topical plan of the discipline .....	6
2.2. Development of didactic process for types of classes .....	7
2.2.1. Lectures, their subject matters and volume .....	7
2.2.2. Laboratory classes, their subject matters and volume .....	8
2.2.3. Self-studying and testing .....	8
<b>3. Methodological guides and teaching materials on the discipline</b> .....	9
3.1. Recommended literature .....	9
3.2. Methodological guides and teaching materials .....	9
<b>4. Students' knowledge and skills grading system</b> .....	10
4.1. Basic terms, concepts, definitions .....	10
4.2. Grading scale for students' learning outcomes assessment .....	11
<b>5. Quality Management System documents</b> .....	14

	Quality Management System. Curriculum of the discipline "Metrology and standardization"	Document code	QMS NAU CUR 07.01.02-01-2012
		Page 4	

## INTRODUCTION

The syllabus on each discipline is necessary for successful teaching process organization according to the European Credit Transfer System. Teachers and students are to be familiarized with it. Grading system is an integral part of the syllabus and provides for assessment of student's knowledge and skills during current, module and semester checks.

Grading procedure is performed according to the national grading scale and European Credit Transfer System grading scale.

### 1. REFERENCE NOTES

#### 1.1. Discipline status in the system of professional training

The knowledge received in the study of subjects allow future professionals to perform measuring and control their implementation in accordance with metrological requirements following their competent presentation in production documentation.

#### 1.2. Aim of the discipline

To teach students methods of ensuring accuracy and traceability inherent in the future professional activity, according to the standards and other regulations. The general orientation of discipline - the study of the main provisions of metrology and compliance with them in the performance measurement and representation of measurement results.

#### 1.3. Tasks for learning the discipline

The main objective of discipline is learning the provisions of metrology and measurement skills specific to future careers.

#### 1.4. Integrated requirements for learning outcomes on the discipline

As a result of mastering the discipline a student shall

##### **KNOW:**

- Legal requirements and regulations of metrology;
- Physical quantities and the basis of their measurements;
- Types, methods and measurement techniques;
- The basis of statistical processing of experimental measurements;
- The basis of ensuring accuracy and traceability;
- Classification of measuring instruments (MI);
- Metrological characteristics and instrumental error of MI;
- Error of measurement results and ways of presenting the results of measurements.

##### **LEARNING OUTCOMES:**

- Justify the selection of types, methods and measurement techniques;
- Carry out statistical processing of measurements experimental data
- Make the choice linear - angular of measuring instruments and use them;
- To estimate the measurement error and represent the results of measurements.

#### 1.5. Integrated requirements for learning outcomes on modules



The subject matter of the discipline is divided into **two** modules.

1.5.1. As a result of studying the material of **module #1** "*Fundamentals of measurements*" a student shall

**KNOW:**

- Legal requirements and regulations of metrology;
- Physical quantities and the basis of their measurements;
- The basis of statistical processing of measurements experimental data
- The basis of ensuring accuracy and traceability.

**LEARNING OUTCOMES:**

- Justify the selection of types, methods: methodologies of measurements;
- Carry out statistical processing of measurements experimental data.

1.5.2. As a result of studying the material of **module #2** "*Measurements and measurement results*" a student shall

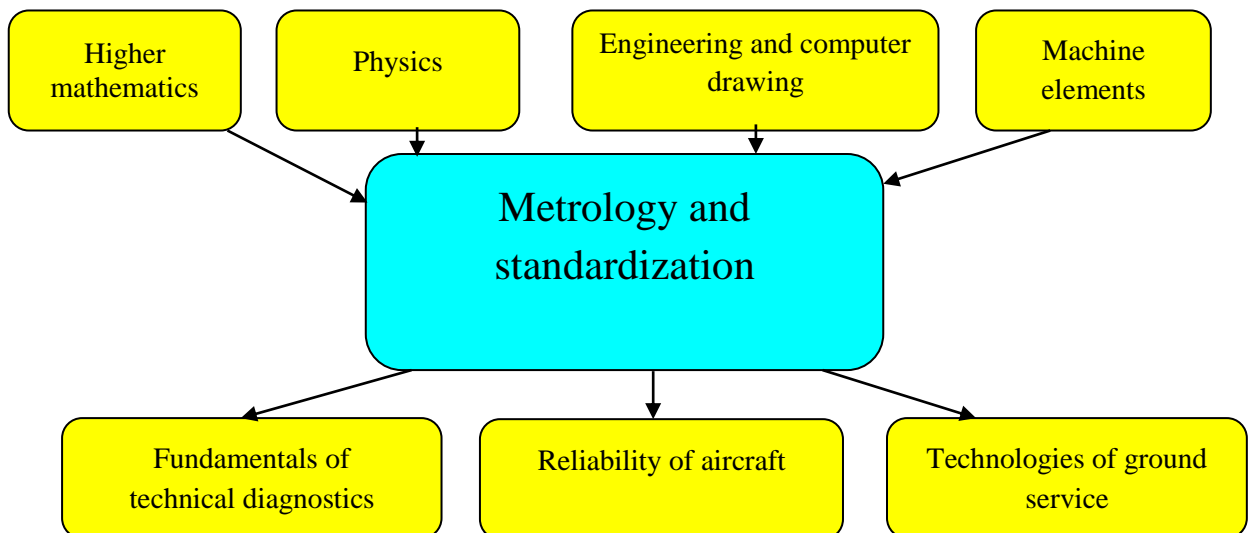
**KNOW:**


- Classification of the MI;
- - Metrological characteristics and instrumental error of the MI;
- - Error of the measurement result (RM) and ways of presenting RM.

**LEARNING OUTCOMES:**

- Make the choice of line - angular MI and use them;
- To estimate the measurement error and represent RM.

**1.6. Interconnection with other disciplines**




	Quality Management System. Curriculum of the discipline "Metrology and standardization"	Document code	QMS NAU CUR 07.01.02-01-2012
		Page 6	

## 2. DISCIPLINE CONTENT

### 2.1. Topical plan of the discipline

Table 2.1

SN	Name of topic	Volume of educational tasks, (by hours)			
		Altogether	Lectures	Lab classes	Self-studying and testing
1	2	3	4	5	6
<b>Semester 5</b>					
<b>Module #1 "Fundamentals of measurements"</b>					
1.1	Metrology and standardization. Regulatory and legal metrology documents.	6	2	2	2
1.2	Physical values and basis of their measurements.	15	2	8	5
1.3	Statistical analysis.	3	2	-	1
1.4	Analysis of errors of measurements and synthesis parameters of accuracy. Bases ensure accuracy and traceability.	3	2	-	1
1.5	Modular test # 1	3	2	-	1
<b>In total on the module # 1</b>		<b>30</b>	<b>10</b>	<b>10</b>	<b>10</b>
<b>Module #2 "Measurements and measurement results"</b>					
2.1	Classification of measuring instruments (MI)	7	2	2	3
2.2	Modern MI linear - angular dimensions and their products for measurement.	6	2	2	2
2.3	Control of form, mutual arrangement of surfaces and axes and surface roughness.	9	2	3	4
2.4	Modular test # 2	2	1	-	1
<b>In total on the module # 2</b>		<b>24</b>	<b>7</b>	<b>7</b>	<b>10</b>
<b>In total in 5th semester on a subject matter</b>		<b>54</b>	<b>17</b>	<b>17</b>	<b>20</b>
<b>In total on a subject matter</b>		<b>54</b>	<b>17</b>	<b>17</b>	<b>20</b>

	Quality Management System. Curriculum of the discipline "Metrology and standardization"	Document code	QMS NAU CUR 07.01.02-01-2012
		Page 7	

## 2.2. Development of didactic process for types of classes

### 2.2.1. Lectures, their subject matters and volume

SN	Name of topic	Volume of educational tasks, (by hours)	
		Lectures	Self-studying
1	2	3	4
<b>Semester 5</b>			
<b>Module #1 "Fundamentals of measurements"</b>			
1.1	Metrology and standardization. Regulatory and legal metrology documents. Law of Ukraine # 113/98- BP. DSTU 2682 - 94	2	1
1.2	Physical values and basis of their measurements. The requirements of standards DSTU 3651 - 97	2	1
1.3	Statistical analysis of experimental values of measurements. The requirements of GOST 8.207 87	2	1
1.4	Analysis of errors of measurements and synthesis parameters of accuracy. The requirements of GOST 11,004 - 74. Requirements MI 1317 - 86	2	1
1.5	Modular test # 1	2	1
<b>In total on the module #1</b>		<b>10</b>	<b>5</b>
<b>Module #2 "Measurements and measurement results"</b>			
2.1	Classification of MI. Metrological characteristics of the FTA and accuracy categories	2	1
2.2	Modern FTA linear - angular dimensions and their choice to perform measurements. The requirements of DSTU 3921 – 99	2	1
2.3	Control of form, the mutual arrangement of surfaces and axes and surface roughness.	2	1
2.4	Modular test # 2	1	1
<b>In total on the module #2</b>		<b>7</b>	<b>4</b>
<b>In total in 5th semester on a subject matter</b>		<b>17</b>	<b>9</b>
<b>In total on a subject matter</b>		<b>17</b>	<b>9</b>



### 2.2.2. Laboratory classes, their subject matters and volume

SN	Name of topic	Volume of educational tasks, (by hours)	
		Lab classes	Self-studying
1	2	3	4
<b>Semester 5</b>			
<b>Module #1 "Fundamentals of measurements"</b>			
1.1.	Regulatory and legal metrology documents	2	1
1.2	Performance of direct measurements	2	1
1.3	Measurement by comparison with measure	2	1
1.4	Performance of indirect measurements	2	1
1.5	Measurements with multiple observations	2	1
<b>In total on the module # 1</b>		<b>10</b>	<b>5</b>
<b>Module #2 "Measurements and measurement results"</b>			
2.1	Statistical analysis of experimental values of measurements and processing of measurement results (MR)	2	2
2.2	Choice of MI and their settings to measure	2	1
2.3	Measurement of surface roughness	2	1
2.4	Measuring deviations from the shape and arrangement of surfaces and axes	1	2
<b>In total on the module # 2</b>		<b>7</b>	<b>6</b>
<b>In total in 5th semester on a subject matter</b>		<b>17</b>	<b>11</b>
<b>In total on a subject matter</b>		<b>17</b>	<b>11</b>

### 2.2.3. Self-studying and testing

SN	Name of the student's Self-study work	Volume of Self-studying (by hours)
1	2	3
<b>Semester 5</b>		
1.	Working of lecture material	7
2.	Preparation for laboratory classes	11
3.	Preparation for the Module Test #2	2
<b>In total in 5th semester on a subject matter</b>		<b>20</b>
<b>In total on a subject matter</b>		<b>20</b>





### 3. METHODOLOGICAL GUIDES AND TEACHING MATERIALS ON THE DISCIPLINE

#### 3.1. Recommended literature

##### Basic literature


- 3.1.1. Закон України про метрологію та метрологічну діяльність #113/98-ВР, 11.02.98.
- 3.1.2. ДСТУ 2681 – 94. Метрологія. Терміни та визначення.
- 3.1.3. ДСТУ 3651 – 97 Одиниці фізичних величин.
- 3.1.4. Новиков В.М., Коцюба А.М., Величко О.М. Основи метрології та метрологічна діяльність. Навчальний посібник. Частина 1 – Київ: Нора – прінт, 2000. – 228с.
- 3.1.5. Шишкин И.Ф. Основы метрологии, стандартизации и контроля качества. – М.: Издательство стандартов, 1988. – 352 с.
- 3.1.6. Бурдун Г.Д., Марков Б.Н. Основы метрологии. Учебное пособие для вузов. М: Издательство стандартов, 1985, 256 с.
- 3.1.7. Тюрин Н.И. Введение в метрологию. Учебное пособие. – М.: Издательство стандартов, 1985, 248с.

##### Additional literature

- 3.1.8. ГОСТ 8.207-76 ГСИ. Прямые измерения с многоразовыми наблюдениями. Методы обработки результатов наблюдений. Основные положения. – Введен 01.01.77.
- 3.1.9. ГОСТ 11.004-74. Правила определения оценок и доверительных границ для параметров нормального распределения.
- 3.1.10. МИ 1317-86 ГСИ. Результаты и характеристики погрешностей измерений. Формы представления. Способы использования при испытаниях образцов продукции и контроля их параметров.
- 3.1.11. ДСТУ 3921.1 – 1999 (ISO 10012.1 - 1992), 3921.2 – 200 (ISO 10012.2 - 1997). Частина 1,2 Вимоги до забезпечення якості вимірювальної техніки.

#### 3.2. Methodological guides and teaching materials

SN	Name of topic	Code of topic by Topical plan	Quantity
1	Basic derivative physical quantities and means of their preservation and reproduction	1.2	3П
2	The laws of distribution of random quantities	1,3	3П
3	Procedures and analytical expressions of results of measurements	1.3, 1.4	3П
4	Structure of measurement errors	1.4	3П
5	Means of measurement and metrological characteristics	2.1	6П,43ВТ

	Quality Management System. Curriculum of the discipline "Metrology and standardization"	Document code	QMS NAU CUR 07.01.02-01-2012
		Page 10	

## 4. STUDENTS' KNOWLEDGE AND SKILLS GRADING SYSTEM

### 4.1. Basic Terms, Concepts, 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: looking out the lecture material, preparation for the practical class, etc. and self-studying (homework, etc.).

Semester Graded test do not require the presence of students and is assigned if the student completed all previous types of training identified by the working syllabus, and received positive (national scale) modular final rating score for each module. At the same teacher for clarification of some items may carry additional control of student work, interviewing, rapid control and more.

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.

4.1.7.1. **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 defending his/her individual tasks at practical classes.


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

4.1.7.3. **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.

4.1.7.4. **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.

4.1.7.6. **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.

The total grade in a discipline taught during a few semesters is determined as the average of the total semester grades in values with its further transfer into the national scale and the ECTS scale. The total grade in a discipline is entered into the Appendix to the Specialist's diploma.

	Quality Management System. Curriculum of the discipline "Metrology and standardization"	Document code	QMS NAU CUR 07.01.02-01-2012
		Page 11	

#### 4.2. Grading Scale for Students' Learning Outcomes Assessment

4.2.1. Grading of different kinds of academic work performed by a student is done in accordance with Table 4.1.

Table 4.1

##### Grading of different kinds of a student's academic work

Semester 5					
Module #1		Module #2		Max Grade	
Kind of Academic Work	Max Grade	Kind of Academic Work	Max Grade		
Fulfillment and defense of Laboratory work # 1.1	8	Fulfillment and defense of Laboratory work # 2.1	8		
Fulfillment and defense of Laboratory work # 1.2	8	Fulfillment and defense of Laboratory work # 2.2	8		
Fulfillment and defense of Laboratory work # 1.3	8	Fulfillment and defense of Laboratory work # 2.3	8		
Fulfillment and defense of Laboratory work # 1.4	8	Fulfillment and defense of Laboratory work # 2.4	8		
Fulfillment and defense of Laboratory work # 1.5	8	<i>For admission to pass module test #2student should have not less than grade 19</i>			
<i>For admission to pass module test #1student should have not less than grade 24</i>					
Module test # 1	8	Module test # 2	8		
<b>Total Module Grade # 1</b>	<b>48</b>	<b>Total Module Grade # 2</b>	<b>40</b>		
<b>Semester Graded test</b>					<b>12</b>
<b>Total 2-d Semester Grade</b>					<b>100</b>

4.2.2. Designed kind of training is credited to the student if he received for it positive grade on a national scale according to Table. 4.2.


Table 4.2

##### Correspondence between different kinds of a student's academic work and the National Scale

Grade values		National Scale
Fulfillment and defense of Laboratory work	Module Test	
<b>Module test # 1, 2</b>	<b>Module test # 1, 2</b>	
8	8	excellent
6-7	6-7	good
5	5	satisfactory
less than 5	less than 5	bad

4.2.3 The amount of grades received by a student for certain types of training performed, is a current module grade, which added to the module control list.

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 – not less than satisfactory according to the national scale – (see Table 4.2), he/she is allowed to take his/her module test.

	Quality Management System. Curriculum of the discipline "Metrology and standardization"	Document code	QMS NAU CUR 07.01.02-01-2012
		Page 12	

4.2.5. Students have their module test in a written form. The procedure, 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 correspondence between Module Test Grade values and the National Scale is shown in Table 4.3.

Table 4.3

**Correspondence between Total Module Grade Values and the National Scale**

Total Module Grade Values		National Scale
Module test # 1	Module test # 2	
43 - 48	36 - 40	excellent
36 - 42	30 – 35	good
29 - 35	24 - 29	satisfactory
less than 29	less than 24	bad

4.2.7. The module is credited to a student if during module control was positively (on a national scale) control module grade (Table 4.2) and positive final 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.

4.2.9. If the student receive an unsatisfactory grade of the control module the student must repeat the modular control in due course.

4.2.10. A Module Test Grade that a student can be given after the second testing cannot be higher than 'good' according to the national scale, i.e. the grade value presented in Table 4.2 is reduced by 1 and is equal to 7.

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 amount of the Total Module Grade points is in Semester Module Grade, which is transferred to the evaluation on a national scale (Table 4.4).

4.2.13. 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 4.6.

Table 4.4

**Correspondence between Semester Module Grade Values and the National Scale**

Semester Grade Values	National Scale
79-88	excellent
66-78	good
53-65	satisfactory
under 53	bad

Table 4.5

**Correspondence between Graded test Values and the National Scale**

Semester Grade Values	National Scale
Graded test	
12	excellent
10	good
8	satisfactory
–	–



4.2.14. The Total Semester Grade is the sum of student's Semester Module Grade and the minimal Graded test Grade established for each category of Semester Module Grades (**12 for "Excellent", 10 for "Good, and 8 for "Satisfactory"**).

4.2.15. 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.

4.2.16. 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.

4.2.17. 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.

Table 4.6

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

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



