Federal State Educational Institution of Higher Professional Education
"National Research Tomsk Polytechnic University"

APPROVED BY
vice-rector, director of
Institute of Cybernetics
_____ A.V. Zamyatin
«___»_____2012

SYLLABUS FOR THE SUBJECT
MATERIAL CUTTING AND CUTTING TOOLS

DEGREE COURSE Educational Program 150700 Mechanical Engineering
SPECIALISATION
Technology, Equipment and Automation of Mechanical Engineering Manufacturing
QUALIFICATION (DEGREE) bachelor
ADMISSION YEAR 2012
YEARs OF STUDY 3 and 4 SEMESTERs 6, 7 and 8
CREDITS 9 (2/4/3)
PREREQUISITES ПЦ.Б.2.0 «Constructional Materials Engineering»; ПЦ.Б.3.0 «Metrology, Standardisation and Certification»; ПЦ.Б.7.0 «Materials Science»
COREQUISITES ПЦ.В.1.2.0 «Metal Cutting Machine Tools»; ПЦ.Б.8.0 «Fundamentals of Mechanical Engineering»; ПЦ.В.1.4.0 «Mechanical Engineering»

ALLOCATION OF CLASS HOURS:

LECTURES	18+18+9=45 hours
PRACTICAL CLASSES	10+17+15=42 hours
LABORATORY WORKS	8+19+0=27 hours
CLASS HOURS IN TOTAL	36+54+24=114 hours
SELF-STUDY TRAINING	96 hours
TOTAL	210 hours

EDUCATION FORM full-time
ASSESSMENT FORM credit test, examination, differential test
PROVIDING DEPARTMENT Department of Automated Mechanical Manufacturing Engineering of Institute of Cybernetics

HEAD OF THE DEPARTMENT _____ A. Yu. Arlyapov

EDUCATIONAL PROGRAM SUPERVISOR _____ A. Yu. Arlyapov

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2012

1. Objectives

The objective of the «Material cutting and cutting tools» course is to develop knowledge, skills and experience in the field of metal cutting, designing, manufacturing and application of common cutting tools.

2. Subject role in Educational Program

The «Material cutting and cutting tools» course is a part of the discipline series ПЦ – Professional disciplines; B.1.1.0 Elective section.

The study of the course is preceded by studying courses of «Constructional Materials Engineering», «Metrology, Standardisation and Certification» and «Materials Science».

After the «Constructional Materials Engineering» course completion the student is to know the following:

- methods of workpiece production;
- methods of cutting, constructions of the common metal cutting tools and machine tools;
- methods of electrophysical and electrochemical machining;
- basic welding methods.

After the «Metrology, Standardisation and Certification» course completion the student is to know the following:

- principles of the Russian unified system of tolerances and fits;
- drawing indications of dimensional tolerances, geometrical tolerances and fits;
- instruments and devices used for measurement of dimensions, surface roughness and inspection of form and location deviations, as well as metrological parameters, peculiarities of adjustment and verification of these instruments;
- basic means and methods of parts accuracy assessment.

After the «Materials Science» course completion the student is to know the following:

- mechanical properties and performance characteristics of the constructional materials;
- methods of heat and chemical heat treatment of metals and metal alloys.

After the «Fundamentals of Mechanical Engineering» course completion the student is to know the following:

- principles of manufacturing processes design;
- sequence for the part surfaces machining depending on the accuracy and surface finish requirements;
- principles of selection of manufacturing equipment depending on required accuracy and volume of production;
- structure and calculation of the component cycle time.

After the «Metal Cutting Machine Tools» course completion the student is to know and apply the following:

- groups, types and capabilities of machine tools;

- shop temperature conditions for operation of machine tools of various accuracy grades;
- overall dimensions and peculiarities of control of various machine tools;
- principles of selection of manufacturing equipment depending on required accuracy and volume of production.

The «Material cutting and cutting tools» course is studied simultaneously with the following courses: «Metal Cutting Machine Tools» (6 and 7 semesters); «Fundamentals of Mechanical Engineering» (6 semester); «Mechanical Engineering» (8 semester) «Engineering Measurements in Mechanical Engineering» (8 semester).

3. Course outcomes

The course outcomes are in agreement with the education results described in the Educational Program 150700 "Mechanical Engineering".

After the completion of the "Material cutting and cutting tools" course student is to:

know

- physics of material cutting;
- types of chip and ways of chip type management;
- chip formation influence on residual stresses, depth and degree of machined surface workhardening;
- types of cutting tools and peculiarities of their use;
- characteristics of cutting tool wear, optimal tool life and methods of cutting capabilities recovery;
- characteristics of the basic methods of machining;
- cutting tools design peculiarities;

be able to

- rationally choose methods of machining depending on the type of workpiece surfaces, workpiece material and surface finish requirements;
- choose cutting tools, grades of cutting tool materials, optimal geometric parameters and cutting parameters;
- choose type and grade of coolant depending on surface finish requirements and economy;
- calculate cutting forces and required machine tool power;
- resharp cutters, drills, core drills and milling cutters;
- calculate values of the cutting tool geometric parameters;

apply the following methods

- calculation of the cutting parameters;
- designing of the form cutters and broaches.

The following competences are formed upon completion of the course:

1. Universal (cultural) -

- an ability to apply basic and special knowledge of math, natural science, humanities and economic sciences in engineering (OK-10).

2. Professional -

- an ability to apply basic laws of natural sciences, methods of mathematic analysis and simulation, basics of theoretical and experimental researches in engineering to design objects and engineering processes in mechanical engineering using standard CAD software (ПК-10);
- readiness to maintain engineering discipline during production, develop new engineering methods of production, apply methods of quality assessment of samples, parts, assemblies and products (ПК-1);
- readiness to apply state-of-the-art methods for developing low-waste, energy-saving and environmentally friendly mechanical engineering techniques, that ensure human safety and protection from potential accidents and natural disasters, readiness to apply methods of conservation of raw materials, energy and other resources (ПК-8).

4. Contents of the course

4.1. Topical contents of the course

The following topics are covered in the course.

4.1.1. Basics of Cutting

Basic trends of mechanical engineering. Free and non-free cutting. Kinematics of cutting and geometry of a cutting edge. Cutting parameters. Machining allowance. Cutting tool material requirements. Cutting tool materials and their properties. Coatings. Cutting tool materials identification codes and application.

Geometric parameters of a turning cutter. Specific features of a shaping tool geometry. Optimum geometry of a turning cutter in accordance with cutting tool material, workpiece material, cutting conditions, workpice surface conditions and accuracy requirements. peculiarities of cutting tools (cutters, drills, mills, broaches) and abrasive tools geometry selection.

Processes that take place in cutting zone. analysis of the deforming processes in cutting. Distribution of deformation and strain in cutting zone. Measurement and calculation of the chip reduction. Chip formation model with a single shear plane. Types of chip and their influence on the machined surface finish. Chip flow management. Residual stresses and machined surface work hardening, methods of measurement. Influence of the surface finish, residual stresses and work hardening of the machined surface on the part reliability and durability.

Forces applied on the tool face and flank. Measurement and calculation of the cutting force components. Types of dynamometers. Work, power and specific work in cutting. Selection of the equipment in accordance with the cutting power. Methods of analysis of the contact load distribution on the cutter surfaces.

Heat processes in cutting. Heat sources and heat flows in cutting zone, methods of analysis. Heat quantities ratio change in relation to the cutting speed raise. Cutting temperature and its measurement. Temperature fields, experimental and theoretical analysis of the fields. Cutting temperature relations. Built-up edge and its influence on surface finish and machining accuracy.

Causes of the cutting tool failures. Types of cutting tool failures. Nature and areas of wear. Criteria of wear, tool life. Tool life equation. Optimum tool life. Cri-

teria of the optimum cutting parameters. Methods of cutting tool change. Lubricating and cooling agents, types of cutting fluids. Machinability criteria. Methods of cutting tools testing. Methods of machinability evaluation. Methods of machinability improvement.

4.1.2. Basic Types of Machining

Turning operations. Types and application of the turning tools. The procedure of selection and calculation of the cutting parameters and required power in turning operations.

Methods of hole machining. Types, capabilities, application, advantages and disadvantages of cutting tools for hole machining. Application sequence of the hole machining tools. Types and capabilities of drills. Types and application of core-drills. Types and application of reamers. The procedure of the selection and calculation of the cutting parameters and required power in drilling, core-drilling and reaming.

Types and application of milling cutters and milling machines. Conventional and climb milling. Kinematics of the side-milling. Uniform milling. Forces acting on the side-milling cutter tooth. Total forces and torque acting on a milling cutter. Specific work in side-milling. Face milling process considerations. The procedure of selection and calculation of the cutting parameters and required power in milling.

4.1.3. Grinding Operations

Types of grinding operations. Types of abrasives. Features of a grinding wheel as a cutting tool. Work of a single grain. Phenomenon of self-sharpening. Principles for the selection of a grinding wheel. Grinding wheel life. Grinding wheels, their codification and applications. The procedure of selection and calculation of cutting parameters and required power in grinding. Technological capabilities of basic types of grinding machines.

4.1.4. Design and Calculation of Broaches and Cutters

Types and application of cutters. Cutters with indexable inserts. Types of the form cutters. Analytical calculation of the profile of a round and prismatic form-cutters.

Patterns of cutting and shaping the work surface in broaching. Types of broaches, their design elements and geometric parameters. Calculation of internal round broaches of the standard and rotor-cut designs. Design features of broaches for faceted, splined holes and for external broaching.

4.1.5. Design and Calculation of Drills, Core-Drills and Reamers

Twist drills. Rake and clearance angles variation along the cutting edges of a drill. Kinematic rake and clearance angles of the main cutting edges. Disadvantages of the twist drill geometry and ways to improve it. Methods of the twist drills sharpening. Modern designs of twist drills. Drill for deep hole drilling.

Types and application of core-drills. Design and geometric parameters. Indexable core-drills. Core-drills with carbide bits. Types, applications and design features of reamers. Inaccuracies in hole reaming. Reamer diameter tolerances. Mounting of a reamer on machine tools. Floating reamers. Conical reamers, single-cutting reamers, boiler reamers.

4.1.6. Design and Calculation of Milling Cutters

Types, tooth shapes, geometric parameters and application of milling cutters. Milling cutters with common teeth and form-relieved teeth. Calculation of the relief value of a tooth, relieved by Archimedean spiral. Methods of tooth relieving. Modern designs of face, plain and end milling cutters.

4.1.7. Design and Calculation of Thread Cutting Tools

Thread cutters and combs, their design and geometrical parameters. Types of taps, design parameters and applications. Types of threading dies, their design elements and geometric parameters. Thread milling cutters and heads, their types, design features and applications.

4.1.8. Design and Calculation of Gear Cutting Tools

Types of gear cutting tools. Advantages of involute gearing. Involute gear cutters, design and geometrical parameters. Gear-shaping heads, principle of operation, advantages and disadvantages. Involute hobbing cutter, principle of operation, advantages and disadvantages. Types of gear circular shaping cutters, their design and geometrical parameters. Calculations of circular shaping cutters. Shavers types, application and operation.

Generating cutting tools for parts with non-involute tooth profile. Types of generating cutting tools. Calculations of spline hobbing cutters. Design and geometrical parameters of the milling cutters.

4.1.9. Cutting Tools for Automated Production

Cutting tool requirements for automated production. Methods to increase the dimensional stability and ways of auto-adjustment and replacement of cutting tools for automated production. The operating information about cutting tool status, wear and breakage. Subsystem of auxiliary tools for CNC machines and machining centers. Subsystem of instrumental support for cell-type production, its structure and organization.

4.2. Course structure according to content indicated above and studying activity category is given in the tables below.

Table 1.1

Course structure
(6 semester)

Section title	Class (hours)			Self-study (hours)	Project work	Total
	Lectures	Practical classes	Lab. Works			
1. Basics of Cutting	8	2	6	12	Test №1	28
2. Basic Types of Machining	6	8	2	14	Test №2	30
3. Grinding operations	4			6	Test №3	10
Total	18	10	8	32		68

Table 1.2

Course structure
(7 semester)

Section title	Class (hours)			Self-study (hours)	Project work	Total
	Lectures	Practical classes	Lab. Works			
4. Design and Calculation of Broaches and Form Cutters	4	4	4	12	Test №4	24
5. Design and Calculation of Drills, Core-Drills and Reamers	4	4	4	12	Test №5	24
6. Design and Calculation of Milling Cutters	6	6	6	18	Test №6	36
7. Design and Calculation of Thread Cutting Tools	4	3	5	12	Test №7	24
Total	18	17	19	54		108

Table 1.3

Course structure
(8 semester)

Section title	Class (hours)			Self-study (hours)	Project work	Total
	Lectures	Practical classes	Lab. Works			
8. Design and Calculation of Gear Cutting Tools	6	6		6	Test №8	18
9. Cutting Tools for Automated Production	3	9		4	Test №9	16
Total	9	15		10		34

4.3 Competences distribution with accordance to course sections

The distribution of the competences, indicated in section 3 of the syllabus, formed upon completion of the course with accordance to course sections is given in the table below.

Table 2

The competences distribution

№	Competences formed	Course sections						
		1	2	3	4	5	6	7
1.	З.7.2		+		+			
2.	З.7.3					+	+	
3.	З.10.2	+		+	+			+
4.	З.14.1	+	+		+			
5.	У.7.2	+	+	+	+			
6.	У.7.3	+		+		+	+	
7.	У.10.2	+				+		+
8.	У.14.1	+	+		+	+		
9.	В.7.2	+		+		+		
10.	В.7.3			+		+	+	
11.	В.10.2	+				+		
12.	В.14.1	+	+	+	+			

5. Educational methodology

Combination of methods and forms of education organization is presented in the matrix (refer to Table 3).

Table 3

Methods and forms of education organization (FEO)

FEO / Methods	Lec-tures	Lab. works	Practical classes	Ws*., Mc**	Self-study	Project work
IT method						
Team work		+			+	
Game		+			+	
Case-study	+					
Experience-based educa-tion	+	+				
Advanced self-study train-ing	+	+			+	
Design method					+	
Exploring approach						
Researching approach						
Other methods						

* – Workshop, ** – Master-class

6. The program for students' self-study

6.1 Students' self-study:

The student's self-study includes routine and creative problem-oriented self-study.

Routine self-study aims to set and expand knowledge and develop the students' skills, it includes:

- doing exercises on the material studied, searching for and reviewing literature sources related to the specific topics of the course;
- homework;
- advanced self-study;
- study of material on given topics;
- self-study for laboratory works and practical classes;
- pre-test activity.

Creative self-study aims to develop rational skills and a set of universal competences, to raise creative potential. Creative self-study includes:

- search, analysis, structuring and presenting of the information;
- research activity and participation in scientific student conferences, seminars and contests.
- analysis of scientific works related to the tasks assigned by a teacher.

6.2. Students' self-study content according to the course:

6.2.1. The list of research questions and research areas:

- study of the effect of the turning cutter geometry on the surface finish, accuracy and productivity;
- study of the deformation processes in cutting;
- study of the effect of the cutting parameters and turning cutter geometry on the residual stresses and work hardening of the machined surface;
- study of the effect of roughness, residual stresses and work hardening of the machined surface on the reliability and durability of the parts;
- study of the statics and dynamics of the cutting process forces using dynamometers of various designs;
- study of the temperature distribution in the cutting wedge and on the working surface of the turning cutter;
- study of the distribution of contact stresses on the working surface of the turning cutter;
- study of the brittle fracture behavior of the cutting tools;
- study of the cutting tools wear behavior;
- study of the lubricant-cooling agent effect on the cutting tools wear;
- study of the effect of cutting parameters and various drills designs on the roughness and accuracy of the machined surface;
- study of the effect of cutting parameters and various core drills and reamers designs on the roughness and accuracy of the machined surface;
- study of the effect of cutting parameters and various end mills designs on the roughness and accuracy of the machined surface;
- study of the effect of cutting parameters and various grinding wheels designs on the surface finish;
- study of the effect of cutting parameters and cutting patterns of the broaches on the surface finish;
- study of the effect of cutting parameters and cutting patterns of the milling cutters on the surface finish.

6.2.2. Topics of individual tasks:

- design of form cutters;
- design of broaches.

6.2.3. Topics for self-study:

- selection of grinding wheels, depending on the workpiece material and the required accuracy and surface finish;
- design of form cutters;
- design of broaches;
- design of involute gear cutters;
- peculiarities of design of cutting tools for automated production;
- peculiarities of design of auxiliary tools for automated production;

6.3. Self-studying results assessment

Assessment of the results of the self-studying is included in everyday assessment and progress assessment. It may use the following ways of assessment: presentation in class, students' review each other's papers, teacher's assessment of the papers, etc.

6.4. Studying and methodological support

6.4.1. References:

1. Кожевников Д.В., Схиртладзе А.Г., Кирсанов С.В. Резание металлов. –М.: Машиностроение, 2007. –304 с.
2. Кожевников Д.В., Кирсанов С.В. Металлорежущие инструменты: Учебник. –Томск: Изд-во Том.ун-та, 2003. –392 с.
3. Справочник технолога-машиностроителя. В 2-х томах, т.2. Под ред. Косиловой А.Г. и Мещерякова Р.К. – М.: Машиностроение, 1985. 496 с., ил.
4. Металлорежущие инструменты/ Г.Н.Сахаров, О.Б.Арбузов и др. М.:Машиностроение, 1989. –328 с.
5. Иноземцев Г.Г. Проектирование металлорежущих инструментов. М.:Машиностроение, 1984, -270 с.
6. Кожевников Д.В., Гречишников В.А., Кирсанов С.В., Кокарев В.И., Схиртладзе А.Г., Режущий инструмент: Учебник для вузов / Под редакцией С.В. Кирсанова. – 2-е изд. Доп. М.: Машиностроение, 2005. 528 с.: ил.
7. Грановский Г.И., Грановский Э.Г. Резание металлов. –М.:Высшая школа, 1985. –304 с.
8. Справочник инструментальщика/ Под ред.И.А.Ординарцева. – Л.:Машиностроение, 1987. –846 с.
9. Справочник конструктора-инструментальщика/ Под ред.В.И.Баранчикова. 1994. –560 с.

10. Протяжки для обработки отверстий/ Д.К.Маргулис, М.М.Тверской и др. –М.:Машиностроение, 1986. –232 с.
11. Нефедов Н.А., Осипов К.А. Сборник задач и примеров по резанию металлов и режущему инструменту. –М.:Машиностроение, 1990. – 448 с.
12. Полетика М.Ф. Теория резания металлов. Учебное пособие. Выпуск 1. Томск, ТПИ, 1974. –186 с.
13. Полетика М.Ф. Теория обработки резанием. Учебное пособие. Часть 2. Томск, ТПИ, 1975. –102 с.
14. Полетика М.Ф. Теория резания металлов. Учебное пособие. Часть 3. Томск, ТПИ, 1980. –95 с.
15. Полетика М.Ф. Фрезерование. Учебное пособие. Томск, ТПУ. 1994. –46 с.

7. Means of the everyday and progress assessment of the results of studying the discipline "Geometric Toleranc-ing and Engineering Metrology"

Everyday assessment is carried out with the help of class participation, written tests and questions asked during the defending of laboratory and practical classes' results, as well as assessment of students' self-study results (refer to the self-study tasks, mentioned in section 6.2).

Progress assessment includes tests, performance assessment, essay writing and personal home-works problem sets (Appendix 1).

8. Rating-list of results of studying the discipline

According to the rating-system the everyday assessment is carried out every month of a semester by pointed rating of theoretical and practical studying results.

The final assessment (examination) is carried out in the end of the semester. Total result is the sum of everyday and final assessment points. The maximum total rating is 100 points (60 – everyday assessment, 40 – final assessment).

9. Teaching, methodological and information support of the course

9.1. Required textbooks:

1. Кожевников Д.В., Схиртладзе А.Г., Кирсанов С.В. Резание материалов. –М.: Машиностроение, 2007. –304 с.
2. Кожевников Д.В., Кирсанов С.В. Металлорежущие инструменты: Учебник. –Томск: Изд-во Том.ун-та, 2003. –392 с.
3. Справочник технолога-машиностроителя. В 2-х томах, т.2. Под ред. Косиловой А.Г. и Мещерякова Р.К. – М.: Машиностроение, 1985. 496 с., ил.
4. Металлорежущие инструменты/ Г.Н.Сахаров, О.Б.Арбузов и др. М.:Машиностроение, 1989. –328 с.
5. Иноземцев Г.Г. Проектирование металлорежущих инструментов. М.:Машиностроение, 1984, -270 с.

9.2. Recommended textbooks:

1. Кожевников Д.В., Гречишников В.А., Кирсанов С.В., Кокарев В.И., Схиртладзе А.Г., Режущий инструмент: Учебник для вузов / Под редакцией С.В. Кирсанова. – 2-е изд. Доп. М.: Машиностроение, 2005. 528 с.: ил.
2. Грановский Г.И., Грановский Э.Г. Резание металлов. –М.:Высшая школа, 1985. –304 с.
3. Справочник инструментальщика/ Под ред.И.А.Ординарцева. – Л.:Машиностроение, 1987. –846 с.

4. Справочник конструктора-инструментальщика/ Под ред.В.И.Баранчикова. 1994. –560 с.
5. Протяжки для обработки отверстий/ Д.К.Маргулис, М.М.Тверской и др. –М.:Машиностроение, 1986. –232 с.
6. Нефедов Н.А., Осипов К.А. Сборник задач и примеров по резанию металлов и режущему инструменту. –М.:Машиностроение, 1990. –448 с.
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8. Полетика М.Ф. Теория обработки резанием. Учебное пособие. Часть 2. Томск, ТПИ, 1975. –102 с.
9. Полетика М.Ф. Теория резания металлов. Учебное пособие. Часть 3. Томск, ТПИ, 1980. –95 с.
10. Полетика М.Ф. Фрезерование. Учебное пособие. Томск, ТПУ. 1994. – 46 с.
11. Cutting Tool Applications. George Schneider, 2005
12. Manufacturing Engineering and Technology. Fifth edition. Serope Kalpakjian, Steven R. Schmid, 2006
13. Mechanical Technology. Material Removal Processes. Compendium. Jan Madl, 1996
14. Metal cutting (4th edition). Edward trent, Paul Wright. 2000, 464 p.
15. Metal cutting mechanics. V.P. Astakhov, 1998, 320 p.
16. Workshop practice (2nd edition). H.S.Bawa. Published by Tata McGraw Hill. 2009
17. www.cme.org Society of Manufacturing Engineers
18. www.cuttingtoolengineering.com

10. Course equipment

Practical and laboratory classes are held in the cutting laboratories, mechanical engineering laboratories and interactive laboratory equipped with CNC machines.

Laboratories equipment include: 1K62 lathe, 3G71P surface-grinding machine, 16K20F3 CNC lathe, MIS-11 Linnik microscope and instruments for linear and angular measurements.

Interactive laboratory is equipped with six operator's CNC stations and two «ARINSTEIN» CNC machines: EMCO CONCEPT TURN 55 lathe and EMCO CONCEPT MILL 155 milling machine. CNC machines and operator panels interface can be switched between Fanuc and Siemens.

Appendix 1

Means of the everyday, progress and final assessment

The following materials refer to the course MC&CT and are to be used for everyday, progress and final assessment.

Samples of the tests for progress assessment

Test 1

1. Denote the geometric parameters in a diagram of the lathe cutter.
2. Specify the zones of plastic deformation in the area of chip formation.
3. Cutting tool materials: basic types, codification, chemical composition, maximum cutting speed and area of application.

Test 2

1. Area and types (nature) of wear, wear criteria.
2. How to determine the optimum tool life? The optimum tool life of a carbide cutter used for roughing operations performed on universal machine tools and semi-finishing operations performed on the CNC machines.
3. Functions and types of coolant.

Test 3

1. Hole machining operations, parameters and accuracy.
2. Two schemes of milling, advantages and disadvantages.
3. The most common tool materials and types of milling cutters.

Test 4

1. Types of grinding operations and abrasives.
2. Codification of grinding wheels (indication of the abrasive type, grain size, structure, bond type, etc.).
3. The procedure of selection and calculation of grinding parameters and power.

Samples of the exam tasks for final assessment

Version 1

1. Name the basic types of milling cutters, field of application, common cutting tool materials for milling cutters.
2. The procedure of calculation of parameters for roughing turning.
3. Types of cutting tool failures.

Version 2

1. Enlist the main types of hole-machining tools and their field of application.
2. Codification of the grinding wheels. The procedure of grinding wheel selection.
3. Methods of cutting temperature analysis.

Version 3

1. Processes in the cutting area during the formation of the main types of chips. Single shear plane.
2. Methods for studying residual stress and work hardening of the machined surface.
3. The procedure of selection and calculation of milling parameters and power.

Version 4

1. Cutting patterns of threading with cutters.
2. Method of forming clearance angles for a threading die. Calculation of the radial relief value.

Version 5

1. Types of gear shaping cutters.
2. Types of broaches.

Version 6

1. Basic geometrical parameters of hobs.
2. Cutting tool materials: grades and properties.

Version 7

1. Chip breaking methods.
2. Types of indexable inserts and methods of clamping.

Version 8

1. Milling cutter nomenclature.
2. Super hard materials.

Version 9

1. Construction and geometry of face milling cutters.
2. Design of spline broaches.

Version 10

1. Types of pointed teeth of milling cutters.
2. Relieving of a milling cutter.

The syllabus is based on the TPU Organization Standard in accordance with Federal State Educational Standard for the 150700 “Mechanical Engineering” program and “Technologies, Equipment and Automation of Engineering Manufacturing” course.

The syllabus is examined and approved at the seminar of AMME Department

(Record № 3 «24» October 2012 г.).

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Science Editor: Skvortsov V.F.