Ministry of Education and Science of Russian Federation
Federal State Autonomous Educational Institution of Higher Professional Education
"National Research Tomsk Polytechnic University"

APPROVED BY
director of
Institute of Cybernetics
_____ S.A. Baidali
«___»_____2016

SYLLABUS FOR THE SUBJECT
MECHANICAL ENGINEERING

DEGREE COURSE: Educational Program 15.03.01 (150700) Mechanical Engineering
SPECIALISATION: Technology, Equipment and Automation of Mechanical Engineering Manufacturing
QUALIFICATION (DEGREE): bachelor
ADMISSION YEAR: 2013
YEAR OF STUDY: 4 SEMESTER: 7, 8
CREDITS: 8 (6 / 2)
PREREQUISITES: Б3.Б3 «Constructional Materials Engineering»; Б3.Б5 «Metrology, Standardisation and Certification»; Б3.Б4 «Materials Science»; Б3.В.1.1 «Material Cutting and Cutting Tools».
COREQUISITES: Б3.В.1.2 « Machine Tools (Metal Working Machines)»; Б3.В.1.1 «Material Cutting and Cutting Tools».
EDUCATION FORM: full-time

	ALLOCATION OF CLASS HOURS		
Kinds of educational activity	7-th semester	8-th semester	Total
LECTURES	40	30	70
PRACTICAL CLASSES	16	---	16
LABORATORY WORKS	24	30	54
CLASS HOURS IN TOTAL	80	60	140
SELF-STUDY TRAINING	46	50	96
TOTAL	126	110	236
ASSESSMENT FORM	examination	examination	

ASSESSMENT FORM: examination
PROVIDING DEPARTMENT: Department of Automated Mechanical Manufacturing Engineering of Institute of Cybernetics

HEAD OF THE DEPARTMENT _____ A. Yu. Arlyapov

EDUCATIONAL PROGRAM SUPERVISOR _____ V.N. Kozlov

TEACHERS _____ V. N. Kozlov
_____ A. B. Kim

2016

1. Objectives

The objective of the «Mechanical Engineering» course is to acquire knowledge, skills and experience in the field of analysis and design of the manufacturing processes with the application of universal equipments and also with the computer numerical control (CNC) system, mastering of modern electrophysical and electrochemical methods of parts (details) machining.

The discipline ensures reaching of following purposes from the General Educational Program (GEP):

- P1 – preparing of a graduate for industrial-technological activity in the field of modern engineering and construction-assembling manufacture on the base of resource effective technologies;
- P2 – preparing of a graduate for design activity with use of computer design aids of articles of machine industry and welding manufacture, master schedules of their manufactures and means of technological equipment of these processes;
- P4 – preparing of a graduate for research activity in the field of creation of innovative production technologies of machine industry articles and construction-assembling plants, means of their technological equipment;
- P5 – preparing of a graduate for self-education and mastering of new professional knowledge and abilities, to continuous professional self-improvement;

2. Subject role in the structure of the General Educational Program (GEP)

The discipline «Mechanical Engineering» concerns cycle Б3.В.1.4 (Variations part (in accordance to profile). The professional module of variations).

The study of the course is preceded by studying courses of «Constructional Materials Engineering»; «Metrology, Standardisation and Certification»; «Materials Science»; «Material Cutting and Cutting Tools», «Metalworking Machinery», «Fundamentals of Mechanical Engineering» (Pre-requirements).

After completion of the «Constructional Materials Engineering» 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.
be able to:
• assign manufacturing way of initial workpiece depending on type of manufacturing;
• carry out an executive drawing of initial workpiece for stamping and casting.

After completion of the «Materials Science» the student is to know the following:
• constructional and cutting tools materials;
• methods of heat treatment;
• structure and mechanical property of constructional and cutting tools materials depending on heat treatment;
be able to:
• assign a mark of constructional and cutting tools materials depending on requirements about hardness, strength and wear resistance.
• assign method of heat treatment of constructional and cutting tools materials depending on requirements about hardness, strength and wear resistance.

After completion of the «Metrology, Standardisation and Certification» the student is *to know*:
• principles of the Russian unified system of tolerances and fits;

• drawing indications of dimensional tolerances, geometrical tolerances and fits;
• methods of tolerance analysis;
• basic means and methods of parts accuracy assessment.
be able to:
• assign measuring tools for product manufacturing;
• measure liner and angular dimensions, surface roughness, errors of a form and surfaces arrangement of a part;
• carry out assembly and executive drawings.

After completion of the «Material Cutting and Cutting Tools» the student is to know the following:
• physics of material cutting;
• characteristics of the basic methods of machining;
• ways of improving machinability of the constructional materials;
• procedures of selection of the cutting tools and cutting parameters.
be able to:
• assign cutting tools and their geometrical parameters for product manufacturing;
• assign and calculate cutting mode.

After completion of the «Fundamentals of Mechanical Engineering» course the student is to:
know
• basic concepts of mechanical engineering production;
• fundamentals of technological ensuring required machining accuracy;
• fundamentals of technological ensuring required properties of the part material and surface layer quality;
• principles and strategies of the manufacturing process design;
• principles of the manufacturing datum selection; methods of calculation of the machining allowances, workpiece dimensions, cutting parameters and standard time for manufacturing operations;
be able to
• determine types of manufacturing;
• choose methods of workpiece production;
• assign tooling for product manufacturing;
• assign manufacturing datums, calculate machining allowances, workpiece dimensions;
• carry out statistical analysis of machining accuracy;
• analyze causes of manufacturing defects and assign ways to eliminate the defects;
apply the following methods
• tolerance analysis of the manufacturing processes;
• statistical analysis of machining accuracy;
• investigation of the surface layer quality;
• deigning of the processes of simple parts job-production

The courses of «Material Cutting and Cutting Tools», «Automation of Mechanical Engineering Manufacturing» are studied simultaneously with the «Mechanical Engineering» course.

3. Course outcomes

The course outcomes are in agreement with the education results described in the General Educational Program 15.03.01 (150700) «Mechanical Engineering».

After completion of the «Mechanical Engineering» course the student is to:
know
• concepts of mechanical engineering production;
• technological ensuring required machining accuracy;
• technological ensuring required properties of the part material and surface layer quality;
• principles and strategies of the manufacturing process design;

- principles of the manufacturing datum selection; methods of calculation of the machining allowances, workpiece dimensions, cutting parameters and standard time for manufacturing operations;

be able to

- calculate types of manufacturing;
- choose way of initial workpiece manufacturing;
- choose methods of workpiece production;
- assign tooling for product manufacturing;
- assign manufacturing datums, calculate machining allowances, workpiece dimensions, cutting parameters and standard time for manufacturing operations;
- carry out dimensional analysis of part machining;
- carry out statistical analysis of machining accuracy;
- analyze causes of manufacturing defects and assign ways to eliminate the defects;

apply the following methods

- tolerance analysis of the manufacturing processes;
- statistical analysis of machining accuracy;
- investigation of the surface layer quality;
- programming the CNC turning and milling machines;
- deigning of the technological processes of complex intricate parts depending on type of manufacturing.

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 (ОК-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).

Table 1

Results of training

Results of training (competences from Federal State Education Standard (FSES)	Components of training results					
	Code	Knowledge	Код	Ability	Code	Mastering of experience
					В.2.1	Experience of application of standards, specifications and other standard documents at execution of design operations
Р2 (ПК-8, ПК-21, ПК-23)	З.2.2	Fundamentals of technological processes design and assembling of	У.2.2	to design master schedules of parts manufacturing and machines assembling	В.2.2	Methodology of the process equipment and attachment choice, forming of parts

		machines				machining and machines assembly routes, a choice of technological bases, methods of the dimensional analyses of master schedules of parts manufacture, a choice of cutting mode, calculation of time norms for parts machining and assembly of machines
P.11 (ПК-11)	3.11.4	Progressive methods of the process equipment maintenance				
Р5 (ПК-1, ПК-2, ПК-3, ПК-4, ПК-6, ПК-16), Критерий 5 АИОР (п. 1.5 ИПр)	З.5.2	The fundamentals of new articles manufacture preparation (opening-up)	У.5.4.	To master and improve master schedules during opening-up of new articles manufacture, to ensure their manufacturability, to inspect observance of technological discipline	В.5.2	Experience of the technological documentation opening-up for articles manufacture

As a result of discipline «Mechanical Engineering» mastering by a student following results should be reached

Table 2

Planned results of discipline mastering

Results of activity	**Result**	Results of training (competences from FSES)
RA1	To know principles of projection of standard engineering articles: step shafts; sleeves; flanges; tooth gears; case-shaped parts.	ПК-8, ПК-21, ПК-23, ПК-11
RA2	To know the basic methods of finishing abrasive machining and surface plastic deformation	ПК-8, ПК-21, ПК-23, ПК-11
RA3	To know methods of an electro-physical and an electro-chemical machining of materials	ПК-23, ПК-11
RA4	To know and to use principles and methodology of projection of master schedules of manufacture of parts on machine tools with CNC systems	ПК-8, ПК-21
RA5	To be able to develop steering programs for turning and milling machine tools with CNC systems	ПК-8, ПК-21
RA6	To be able to execute adjustment of a CNC machine tool for machining a batch of parts	ПК-8, ПК-21

4. Structure and contents of the course

4.1. Topical contents of the course

The following topics are covered in the course.

7-th semester

4.1.1. Production process design (6 hours)

Input data. Analysis of part drawing specification and identification of part manufacturing objectives. Manufacturability analysis. Production methods identification. Initial workpiece selection

depending on type of manufacturing. Manufacturing datums selection depending on type of manufacturing. Selection of manufacturing routes, machine tools and equipment depending on type of manufacturing. Machining operation structure. Principles and sequence of manufacturing process design. Calculation of machining allowances and manufacturing dimensions. Selection of machining parameters, means of ensuring required productivity and accuracy of products. Analysis of production cost-effectiveness.

Laboratory Works

1. Manufacturing datums selection depending on type of manufacturing (2 hours).
2. Manufacturing routes design (2 hours);
3. Measurement of time for carry out of operation (2 hours).

Practical Classes

1. Analysis of parts drawing specification (2 hours);
2. Manufacturability analysis, determination of initial workpiece type and shape (2 hours);
3. Calculation of machining allowances and manufacturing dimensions (2 hours);

4.1.2. Ensuring efficiency of production process (6 hours)

Production time. Production time resource and expenditure. Structure of the time required for machining operation. Machining time rating and work measurement. Technological methods of productivity boosting and manufacturing cost reduction. Improving technical-economic efficiency of manufacturing. Technological ways of increasing machining productivity. Reduction of materials removal. Multiple-machine machining. Typification of manufacturing processes. Prime cost minimization.

Laboratory Works

1. Increasing of machining productivity (2 hours).

4.1.3. Manufacturing technology of standard parts (details). Manufacturing technology of step shafts (6 hours)

Assignment of shafts. Specifications and norms of accuracy. Materials and ways of initial workpiece manufacture. Principles of manufacturing datums selection for rough and finish operations. Accuracy within an operation and through the whole production process. Components of surface layer quality and their performance characteristics. Technological heredity. Standard master schedules of step shafts manufacture depending on type of manufacturing.

Laboratory Works

1. Machining of step shaft and measurement of it accuracy (2 hours);
2. Measurement of shaft technological heredity (2 hours).

Practical Classes

1. Step shaft master schedule design (2 hours).

4.1.4. Manufacturing technology of parts of type a sleeve and a flange (4 hours).

Assignment of sleeves. Specifications and norms of accuracy. Materials and ways of initial workpiece manufacture. Standard master schedules of sleeves manufacture depending on type of manufacturing. Assignment of flanges. Specifications and norms of accuracy. Materials and ways of initial workpiece manufacture. Standard master schedules of flanges manufacture depending on type of manufacturing.

Laboratory Works

1. Machining of sleeve and measurement of it accuracy (2 hours);
2. Machining of flange and measurement of it accuracy (2 hours)

Practical Classes

1. Sleeve master schedule design (2 hours).

4.1.5. Manufacturing technology of gear wheels (4 hours).

Assignment and classification of gear wheels. Specifications and norms of accuracy. Materials and ways of initial workpiece manufacture. Machining of teeth and methods of their finish machining. Standard master schedules of gear wheels manufacture depending on type of manufacturing.

Laboratory Works

1. Machining of gear wheel and measurement of it accuracy (2 hours).

4.1.6. Manufacturing technology of body-case parts (4 hours).

Assignment and classification of body-case parts. Specifications and norms of accuracy. Materials and ways of initial workpiece manufacture. Methods of control of surfaces arrangement accuracy of body-case parts. Standard master schedules of body-case parts manufacture depending on type of manufacturing.

Laboratory Works

1. Machining of body and measurement of it accuracy (2 hours).

Practical Classes

2. Body master schedule design (2 hours).

4.1.7. Methods of finishing abrasive machining (4 hours).

Honing, super finishing abrasive machining, lapping, polishing (buffing). Technological possibilities, advantages and disadvantages (merits and demerits).

4.1.8. Electro-physical and electro-chemical methods of parts processing. Surface plastic deformation (4 hours).

Electrical discharge machining (EDM). Chemical milling and electrochemical machining (ECM). Ultrasonic machining (USM). Laser machining (LM). Electron beam machining (EBM). Plasma flame processing (PFP). Abrasive jet machining (AJM), hydro-abrasive machining (HAM). Recovering (restoration) of parts by gas-flame spraying. Processing by surface plastic deformation. A running by balls and rollers. A diamond burnishing. Calibrating. The shot peening. Technological possibilities, merits and demerits.

Laboratory Works

1. Machining of part on EDM machine tool (2 hours).
2. Abrasive jet machining of workpiece (8 hours)

8-th semester

4.1.9. Design features of CNC machine tools (2 hours)..

Machining of workpieces on machine tools with computer numerical control (CNC) system.

Laboratory Works

1. The control panel of the CNC machine tool, the software (4 hours);
2. Base principles of programming in system Fanuc (8 hours);
3. Systems of coordinates, linear interpolation, creation of the cutting tools and the table of instruments (4 hours);
4. Installation of a workpiece and its binding, assembly of the instrument with a mandrel, its installation and a binding (4 hours);
5. Creation and editing of steering programs and their fine-tune in a simulation condition on the simulator EMCO Win NC (4 hours);
6. Correction for the cutting tool, conditions of limitation of correction application (2 hours);
7. Fine-tune and editing of the steering program by shots (2 hours);
8. Fine-tune of the steering program in an automatic mode (2 hours);
9. Fillet and rounding off, circular interpolation (2 hours);

4.1.10. Technological attachment (20 hours).

Classification of technological attachment. Types of self-centering chucks. Types of drives for mechanized chucks. Types of drives for mechanized chucks. Independent 4-jaws chuck. Locating, adjustment and clamping of workpiece. Colette chuck. Calculation of clamping and axial forces. Mandrels. Calculation of clamping and axial forces of self-centering mandrel. Faceplate. Locating and clamping of workpiece. Drilling attachments. Hand and air operated jig conducter. . Milling

attachments. Calculation of clamping force for key slot milling. Analysis of the attachment application cost-effectiveness.

4.1.11. **Fundamentals of product assembling processes** (8 hours).

General concepts. Classification of joining methods. Types of assembly. Forms of assembly organization. Principles of assembling process design. Input data and sequence of assembling process design. Analysis of assembly drawings for manufacturability. Design of assembly sequence. Assembling process design. Scheme of an assembly. Calculation of a timing period (time rating) of issue; calculation of assembly type; a choice of the form of assembly organization.

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

Table 3

Course structure (7-th semester)

Sectional title/ Themes of lessons	Lectures	Practical classes	Lab. works	Self-study (hours)	Total hours
1. Production process design	6	6	---	6	18
2. Ensuring efficiency of production process	8	6	4	8	26
3. Standard manufacturing technology of parts	18	4	14	24	60
4. Methods of workpiece machining	8	---	6	8	22
Total	**40**	**16**	**24**	**46**	**126**

Table 4

Course structure (8-th semester)

Sectional title/ Themes of lessons	Lectures	Practical classes	Lab. works	Self-study (hours)	Total hours
5. **Design features of CNC machine tools**. Machining of workpieces on machine tools with computer numerical control (CNC) system.	2		30	2	34
6. **Technological attachments.** Classification of attachments. Types and design features of attachments, calculations, fields of application, merits and demerits	20			40	60
7. **Fundamentals of product assembling processes.** General concepts. Classification of joining methods. Types of assembly. Forms of assembly organization. Assembling process design. Scheme of an assembly.	8			8	16
Total	**30**	**---**	**30**	**50**	**110**

Table 5

Practical classis and laboratory works names (7-th semester)

№	Practical classis	hrs		№	Laboratory works	hrs
1	Analysis of parts drawing specification	2				
2	Manufacturability analysis, determination of initial workpiece type and shape	2				
3	Calculation of machining allowances and manufacturing dimensions	4				
				1	Manufacturing datums selection depending on type of manufacturing	2
				2	Manufacturing routes design	2
				3	Measurement of time for carry out of	2

					operation	
4	Step shaft master schedule design	4		4	Increasing of machining productivity	2
				5	Machining of step shaft and measurement of it accuracy	2
				6	Measurement of shaft technological heredity	2
				7	Machining of step sleeve and measurement of it accuracy	2
5	Sleeve master schedule design	2		8	Machining of flange and measurement of it accuracy	2
				9	Machining of gear wheel and measurement of it accuracy	2
				10	Machining of body and measurement of it accuracy	2
6	Body master schedule design	2		11	Machining of part on EDM machine tool	2
				12	Abrasive jet machining of workpiece	2
	Total	**16**			**Total**	**24**

Table 6

Practical classis and laboratory works names (8-th semester)

№	Practical classis	№	Laboratory works	hrs
		1	The control panel of the CNC machine tool, the software	4
		2	Base principles of programming in system Fanuc	8
		3	Systems of coordinates, linear interpolation, creation of the cutting tools and the table of instruments	4
		4	Installation of a workpiece and its binding, assembly of the instrument with a mandrel, its installation and a binding	2
		5	Creation and editing of steering programs and their fine-tune in a simulation condition on the simulator EMCO Win NC	4
		6	Correction for the cutting tool, conditions of limitation of correction application	2
		7	Fine-tune and editing of the steering program by shots	2
		8	Fine-tune of the steering program in an automatic mode	2
		9	Fillet and rounding off, circular interpolation	2
			Total	**30**

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 7

The competences distribution

№	Competences formed	Course sections						
		1	2	3	4	5	6	7
1.	З.2.2	+	+	+	+			+
2.	З.5.2		+	+	+			+
3.	З.11.4					+		+
4.	У.2.2			+	+	+		+
5.	У.5.4		+		+	+	+	+
6.	В.2.1	+		+	+	+	+	+
7.	В.2.2				+	+	+	
8.	В.5.2			+		+		+

5. Educational methodology

A description of educational technology, ensuring the achievement of the expected results of development of the discipline are given in the section. Combination of methods and forms of education organization is presented in the matrix (refer to Table 3).

Table 8

Methods and forms of education organization (FEO)

FEO Methods	Lec-tures	Lab. works	Practical classes	Ws*., Mc**	Self-study	Project work
Team work		+	+		+	
Game						
Case-study						
Experience-based education	+	+	+			
Advanced self-study training	+				+	
Projects			+		+	
Exploring approach	+	+			+	
Researching approach	+	+				

* – Workshop, ** – Master-class

Course project

The academic year project consists from explanatory note in volume 25... 30 pages of format A4 and 3... 4 sheets of format A1 of a graphic part.

As a rule, the academic year project contains manufacturing technology (master schedule) of one part. The composition and volume of separate workings out is regulated in methodical instructions for academic year project execution.

Volume of self-study activity for course project execution is 32 hours.

6. Program for students' self-study

The purpose of students' self-study is to develop common cultural and professional skills, ability and readiness for self-educational activity for a lifetime.

Students' self-study is organized in accordance with the following principles:

- systematic studying;
- effectiveness;
- planning;
- continuous monitoring and control;
- motivation;

- effective use of information technologies.

Timetable of students' self-study is given in the rating-list.

Self-study is carried out in the Scientific and Technical Library of TPU (Belinsky street, 55), with the help of the literature collection and computer laboratory of the department (Timakova street, 12, building 16a TPU).

Table 9

Results of teaching

Assessment procedures	Results of teaching
Checking before laboratory works	RA 1, RA 2, RA 3, RA 4, RA 5, RA 6
Defense of laboratory works	RA 1, RA 2, RA 3, RA 4, RA 5, RA 6
Preparing for practical classes	RA 1, RA 3, RA 6
Progress assessment (check works)	RA 1, RA 2, RA 3
Course project	RA 1, RA 2, RA 3, RA 4
Final assessment (examinations)	RA 1, RA 2, RA 3, RA 4, RA 5, RA 6

For quality estimation of discipline mastering at inspection actions following means (fund of estimating means) are provided:

1. Super finishing, cutting parameters of machining and fields of application.
2. Methods of key slots machining.
3. The diamond burnishing, parameters of processing and filds of application.
4. Methods of slit surfaces machining.
5. Principles of routes choice of separate surfaces machining.
6. Principles of initial workpiece choice.
7. The shot-peening, processing parameters and fields of application.
8. The design procedure of cutting mode calculations and choice.
9. Electrochemical machining of materials.
10. The standard route of step shafts machining.
11. Electrical discharge machining of parts.
12. Methods of gear teeth machining.
13. Essence and technological possibilities of running by balls.
14. Essence and technological possibilities of polishing and lapping.
15. Control of surfaces arrangement of case-shaped parts.
16. Methods of flat surfaces machining of case-shaped parts.
17. Methods of basic holes machining with high accuracy arrangement in case-shaped parts.
18. Hypersonic washing of parts.
19. Laser machining.
20. The standard route of a tooth gear machining.
21. Application of ultrasound for an intensification of cutting processes.
22. Principles of the process equipment choice.
23. Classification of technological attachment.
24. Attachment for turning processes.
25. Attachment for drilling processes.
26. Attachment for milling processes.
27. Classification of joining methods.
28. Types of assembly.
29. Forms of assembly organization.
30. Principles of assembling process design.
31. Scheme of an assembly.

6.1. Students' self-study forms

Self-study is organized at the following levels:

- reproductive;
- cognitive-search;
- creative.

Within these levels, 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. List of scientific themes and research investigations:
- investigation of dimensional accuracy and surface layer quality of small diameter holes machined by mandrelling;
- controlling residual stresses and accuracy of the mandrelled small diameter holes;
- ways of increasing productivity and accuracy of the deep hole drilling;
- geometrical parameters of indexable cutting tools;
- investigation of non-free cutting by cutting tools with edges of a complex shape.

6.2.2. Topics of personal assignment:
- lathe self-centering chucks;
- collet chucks;
- magnetic and electromagnetic chucks;
- vacuum operated fixtures;
- centerless grinding;
- honing and siperfinishing;
- cold working of workpieces;
- methods of part labeling;
- methods of deburring;
- methods of sheet material cutting;
- trends in teat treatment and chemical-heat treatment;
- trends in machining with cutting tools;
- trends in machining with abrasive tools;
- trends in casting methods.

6.2.3. Topics for self study:
- design for manufacturing;
- technological heredity.

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 of self-study

6.4.1. References:

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26. http://www.ctemag.com/
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30. www.thomasnet.com/
31. www.efunda.com/home.cfm
32. www.globalspec.com/
33. www.icademic.org/97445/Mechanical-Engineering
34. www.engcen.com/mechjobs.htm
35. www.theengineer.co.uk/
36. www.engc.org.uk/
37. www.engineersedge.com/
38. www.eef.org.uk/
39. www.researchgate.net

7. Means of the everyday and progress assessment of the results of studying "Mechanical Engineering"

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).

Transfer of final rating mark in other scale

Final mark	Traditional estimation	Warranty estimation
96 - 100	Excellent	A+
90 - 95		A
80 - 89	Good	B+
70 - 79		B
65 - 69	Satisfactory	C+
55 - 64		C
55 - 100	Passed	D
0 - 54	Bad/not passed	F

The scheme of estimation of results of intermediate certification

Credit test	**Course Project (CP) or Course Work (CW), report about Student's Scientific (Teaching) Research Work (SSRW/STRW)**	Estimation definition
39 - 40	57 - 60	Excellent
35 – 38	52 – 56	Very good
31 – 34	46 – 51	Good
27 – 30	39 – 45	Satisfactory
22 – 26	33 – 38	Mediocre
17 – 21	29 – 37	Conditionally unsatisfactorily
0 – 16	0 – 28	Certainly unsatisfactorily

For full time teaching

Type of attestation	Progress assessment (second check point)		Progress assessment (attestation point)	
	Minimum admissible quantity of points	Maximum admissible quantity of points	Minimum admissible quantity of points	Maximum admissible quantity of points
Exam /Credit test	33	60	22	40
CP/CW, report abut SSRW/STRW	22	40	33	60

9. Teaching, methodological and information support of the course

9.1. Required textbooks:

1. Fundamentals of mechanical engineering: textbook / Skvortsov V.F., TPU, Tomsk: TPU publishing house, 2013. – 234 p.
2. Technology of Mechanical Engineering. Part 1. Textbook / Kozlov V.N. Tomsk: TPU Press, 2001, 134 pp.
3. Technology of Mechanical Engineering. Part 2. Textbook . / Kozlov V.N. Tomsk: TPU Press, 2002, 148 pp.
4. Machine Tool Technology / Repp V.E., McCarthy W.J., McKnight Publishing Company, Glencol, 1984.
5. Основы технологии машиностроения: учебное пособие / В. Ф. Скворцов ; Национальный исследовательский Томский политехнический университет (ТПУ). — Томск: Изд-во ТПУ, 2012. — 352 с.: ил.
6. Скворцов В.Ф. Выбор технологических баз при изготовлении деталей. Учебное пособие. – Томск: Изд-во ТПУ, 2007. –56 с.
7. Скворцов В.Ф. Основы размерного анализа технологических процессов изготовления деталей. – Томск: Изд-во ТПУ, 2009. –91 с.
8. Encyclopedia of production and manufacturing management / Editor Paul M. Swamidass. Kluwer Academic Publishers, 2000.
9. Foster L.W. Geometrics III: The application of geometric and tolerancing technique. Addison-Wesley, 1994.
10. Handbook of Manufacturing Engineering / Edited by Jack M. Walker. Mar-cel Dekker, 1996.
11. Manufacturing Engineering and Technology. Fifth edition. Serope Kalpakjian, Steven R. Schmid, 2006.

9.2. Recommended textbooks:

12. Машиностроение. Энциклопедия. Т. III-3. Технология изготовления деталей машин / А.М. Дальский, А.Г. Суслов, Ю.Ф. Назаров и др.; под общ. ред. А.Г. Суслова. –М.: Машиностроение-1, 2000. –840 с.
13. Справочник технолога-машиностроителя. В 2-х т. Т. 1 / Под ред. А.М. Дальского, А.Г. Косиловой, Р.К. Мещерякова, А.Г. Суслова. – М.: Ма-шиностроение-1, 2003. –912 с.
14. Справочник технолога-машиностроителя. В 2-х т. Т. 2 / Под ред. А.М. Дальского, А.Г. Косиловой, Р.К. Мещерякова, А.Г. Суслова. – М.: Ма-шиностроение-1, 2003. –944 с.
15. Ashby, M.F., Materials selection in Mechanical Design, 3rd ed., Elsevier, 2005
16. ASM Handbook, Vol. 4: Heat Treating, ASM International, 1991
17. Boljanovic, V., Sheet Metal Forming Process and Die Design, Industrial Press, 2004

18. Boothroyd, G., Dewharst, P. and Knight, W., Product Design for Manufacture and Assembly, 2nd edition, Marcel Dekker, 2001
19. Dieter, G.E., Kuhn, H.A. and Semiatin, S.L., Handbook of Workability and Process Design, ASM International, 2003
20. Drake P. Dimensioning and tolerancing handbook. McGraw-Hill, New York, 1999.
21. Encyclopedia of production and manufacturing management / Editor Paul M. Swamidass. Kluwer Academic Publishers, 2000.
22. Foston, A.L., Smith, C.L. and Au, T., Fundamentals of Computer-Integrated Manufacturing, Prentice Hall, 1991
23. Galyer J.F.W., Shotbolt C.R. ―Metrology for Engineers‖, Cassell, 1969.
24. Handbook of Manufacturing Engineering / Edited by Jack M. Walker. Marcel Dekker, 1996.
25. Ibrahim Z. Mastering CAD/CAM. McGraw-Hill, New York, 2005.
26. ISO 8015:1985, Technical drawings – Fundamental tolerancing principles
27. Luggen, W.W., Flexible Manufacturing Cells and Systems, Prentice Hall, 1991
28. Machine Shop Practice. Fifth edition. Karl Hans Moltrecht, 1979.
29. Manufacturing Engineering and Technology. Fifth edition. Serope Kalpakjian, Steven R. Schmid, 2006.
30. Mechanical Engineer's Handbook / Edited by Dan B. Marghitu. Academic Press, 2001.
31. Precision Manufacturing, by David Dornfeld and Dae-Eun Lee, Springer, 2008.
32. Rechetov, D.N. and Portman, V.T., Accuracy of Machine Tools, ASME International, 1989
33. Shaw, M.C., Metal Cutting Principles, 2nd ed., Oxford, 2005
34. Shetty, D., Design for Product Success, Society of Manufacturing Engineers, 2002
35. The fundamentals of product design. R. Morris. AVA Publishing, 2009.

9.3. Internet sources

1. http://e-le.lcg.tpu.ru/public/OTM_0771/index.html
2. http://www.mitcalc.com/doc/tolerances/help/en/tolerances.htm – Calculation packet MITCalc

10. Course equipment

Practical and laboratory classes are held in the mechanical engineering labora-tory and interactive training room equipped with CNC machines.

The mechanical engineering laboratory is equipped with a lathe 1К62, surface grinding machine 3Г71П, CNC turning machine 16К20Ф3, Linnik micro-scope for roughness measurements МИС-11 and instruments for linear and angular measurements.

The interactive training room is equipped with CNC machines EMCO CONCEPT TURN 55 and EMCO CONCEPT MILL 155 and six workplaces with computers; both machines and workplaces are equipped with replaceable CNC panels of Fanuc and Siemens systems.

Appendix 1

Means of the everyday, progress and final assessment

The following materials refer to the course FME and are to be used for every-day, progress and final assessment.

Samples of the tests for progress assessment

Test 1

1. Name types of products in mechanical engineering.
2. What is the sequence of development of a uniform manufacturing process?
3. What requirements must be met by the part design for assemblability?

Test 2

1. Give classification of assembling processes according to stages of the assembly process and level of mechanization and automation.
2. How do grinding parameters influence surface layer quality?
3. What are manufacturing means?

Test 3

1. What parameters characterize quality of products?
2. What parameters are used to evaluate productivity?
3. What is the essence of ensuring accuracy of the resulting dimension by the adjustment method?

Test 4

1. How does chemical-heat treatment (carburizing, nitriding, carbonitriding) change properties of workpieces?
2. What is the aim of setting a manufacturing system for machining a batch of workpieces?
3. What is manufacturability of a product design?

Samples of the exam tasks for final assessment

Version 1

1. What parameters characterize accuracy of a part and of a machine?
2. What is the essence of ensuring accuracy of the resulting dimension by the complete interchangeability method?
3. Task

Version 2

1. How can the dimensional diagram of the manufacturing process be constructed?
2. How do grinding parameters influence surface layer quality?
3. Task

Version 3

1. How can you construct assembly diagrams?
2. What is an operation?
3. Task

Version 4

1. What part of the operation cycle per part is called machining time?
2. What are the requirements that the workpiece design must comply with for manufacturability?
3. Task

Version 5

1. What part of the operation cycle per part is called auxiliary time?
2. What is the essence of ensuring accuracy of the resulting dimension by the complete interchangeability method?
3. Task

Version 6

1. What parameters characterize accuracy of a part and of a machine?
2. What is the essence of ensuring accuracy of the resulting dimension by the fit-ting method?

Version 7

1. What dimensions are resulting in dimensional chains formed during the manu-facture of parts?
2. Why does the method of trial cuts provide higher accuracy compared to ma-chining on pre-set machine tools?
3. Task

Version 8

1. What is set-up time?
2. How can you enhance material properties of the cast and formed workpieces?
3. Task

The syllabus is based on the TPU Organization Standard in accordance with Federal State Educational Standard for the 15/03/01 (150700) ―Mechanical Engineering program and ―Technologies, Equipment and Automation of Engineering Manufacturing course.

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