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
Machine Shops Design

DEGREE COURSE: Educational Program 15.03.01 (150700) Mechanical Engineering
SPECIALISATION: Technology, Equipment and Automation of Mechanical Engineering Manufacturing
QUALIFICATION (DEGREE): bachelor
ADMISSION YEAR: 2014
YEAR OF STUDY: 4 SEMESTER: 8
CREDITS: 3
PREREQUISITES: Б3.Б3 "Constructional Materials Engineering"; Б3.Б5 "Metrology, Standardisation and Certification 1.1"; Б3.Б4 "Materials Science", Б3.В.1.1 "Material Cutting and Cutting Tools", Б3.В.1.2 "Machine Tools (Metal Working Machines)", ДИСЦ. Б3.Б10. "Fundamentals of Mechanical Engineering"
COREQUISITES: Б3.В.1.4 "Mechanical Engineering"
EDUCATION FORM: full-time

Kinds of educational activity	ALLOCATION OF CLASS HOURS
LECTURES	20
PRACTICAL CLASSES	---
LABORATORY WORKS	20
CLASS HOURS IN TOTAL	40
SELF-STUDY TRAINING	48
TOTAL	88
ASSESSMENT FORM	credit test

ASSESSMENT FORM: credit test
PROVIDING DEPARTMENT: Department of Automated Engineering Technology of Institute of Cybernetics

HEAD OF THE DEPARTMENT _____ A. Yu. Arlyapov

EDUCATIONAL PROGRAM SUPERVISOR _____ V.N. Kozlov

TEACHERS _____ V. N. Kozlov

2016

1. Objectives

The objective of the "Machine Shops Design" course is to acquire knowledge, skills and experience in the field of calculation demanded quantity of process equipment, area of shop, , developing a layout of process and auxiliary equipments and projection of auxiliary system, developing a general layout of the factory and project feasibility study.

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 Educational Program

The "Machine Shops Design" course is a part of the discipline series ДИСЦ. Б3.В.1.7 (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 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.

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 "Mechanical Engineering", "Automation of Mechanical Engineering Manufacturing" are studied simultaneously with the ««Machine Shops Design" 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».

As a result of studying the discipline "Machine shops design" a student should:

know:

- Basic principles of organizing production departments and shops;
- Techniques of choosing shop structure and organizational forms of its basic divisions;
- The content of technical, organizational, economic and social problems solved at designing;
- Main principles of designing shops;
- Structure and functions of all services of the auxiliary system;
- Sequence of developing a technical design assignment.

be able to:

- Calculate labour input of annual processing of all products in the shop depending on manufacture seriality;
- Calculate the batch size;
- Arrange the shop depending on manufacture seriality;
- Calculate the required quantity of equipment, floor space of the shop and its divisions;
- Carry out a rational layout of the equipment in the shop when building a new premise and reconstructing the old one;
- Calculate the required floor space and carry out a layout of the auxiliary services of the shop and factory;
- Choose a type of the building and its arrangement depending on the requirements for the accuracy of live parts, technical characteristics of assembled mechanisms and manufacture seriality;
- Choose cutting tools, tip grades, optimum geometrical parametres and cutting mode;
- Develop tasks for building, sanitary and power sections;
- Develop a general plan of the factory;
- Make a feasibility report of the project.

master:

- Calculation of the required quantity of equipment, floor space of the shop and its divisions;
- Performance of a rational layout of the equipment in the shop when building a new premise and reconstructing the old one;
- auxiliary system design.

While mastering the discipline the following expertise is evolved in students:

1. General:

- to apply basic and special knowledge in the field of mathematical, natural, humanitarian and economic sciences for complex engineering practice on the base of the entire system of scientific knowledge of the world around.

2. Professional:

- to apply fundamental laws of disciplines studying natural sciences, methods of mathematical analysis and modeling, fundamentals of theoretical and experimental studies in complex engineering practice in order to model objects and technological processes in mechanical engineering by using standard packages and computer design aids for machine-building enterprises and shops;
- to enforce technological discipline when producing articles of machine-building manufacture, to master new technological processes of production, to apply quality control techniques for samples, mechanisms and their parts;
- to apply advanced methods for developing low-waste, energy- conserving and environmentally-clean machine-building technologies which ensure human health and safety as well as their protection against possible consequences of accidents, catastrophes and natural calamities, to apply

methods of rational use of raw material, power and other kinds of resources in mechanical engineering.

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
P2 **Engineering projection** (ПК-8, ПК-21, ПК-23)					В.2.1	Experience of application of standards, specifications and other standard documents at execution of design operations
	З.2.2	Fundamentals of technological processes design and assembling of machines	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 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
P5 **Engineering practice** (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
Р.11 (ПК-11)	З.11.4	Progressive methods of the process equipment maintenance				

As a result of discipline 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 machine shops	ПК-8, ПК-21, ПК-23, ПК-11
RA2	To know the basic methods of labour input calculation to process the annual programme of all parts in the shop	ПК-8, ПК-21, ПК-23, ПК-11
RA3	To know methods of an equipment layout	ПК-23, ПК-11

RA4	To know and to use principles and methodology of projection of master schedules of parts manufacture for small batch production	ПК-8, ПК-21
RA5	To be able to calculate and design auxiliary system	ПК-8, ПК-21
RA6	To be able to perform the general layout of a factory (enterprise)	ПК-8, ПК-21

4. Course structure and content

4.1. ***Course content:***

4.1.1. **Main goals, principles and sequence of design**

Types of education activity:

Lectures (4 hrs):

- *Basic directions of developing mechanical engineering in Russia and abroad, the role of reconstructing and modernizing existing machine-assembling manufactures. The content and stages of manufacturing processes. Main principles of organizing manufacturing divisions. A methodology of choosing a shop structure and organizational forms of its basic divisions. Defining the structure and quantity of the basic production machinery for each division. Variety (spectrum) and volume of output. Seriality of manufacture. Requirements of environment protection and waste recycling. Basis for design. Project design works. General requirements for a layout of divisions and shops. Feasibility reports on designing and building or reconstructing manufacture.*
- *Project description. Contents of technical design assignment. Sequence of designing. Making technical design assignment. Consideration and approval procedures of technical design assignment. Sequence of design and building. Use of computer-aided design (CAD) systems for designing divisions and shops. The contents of technical, organizational, economic and social problems solved at design. Criteria of choosing an optimum variant of the project. Main design principles.*

Laboratory works (4 hrs):

- *drawing a shop floor layout not to scale;*
- *performing a shop floor layout to scale.*

4.1.2. **Design of shop floor production**

Calculation of total labour input of the annual program of all products. Calculation of batch size, machine tools quantity and floor space (area). A layout of the basic (technological) equipment at manufacturing divisions.

Types of education activity:

Lectures (6 hrs):

- *Raw (initial) data for design. Basic directions of choosing the structure of the production machinery for flow-line and non-line production. The analysis of industrial manufacturability of products. Defining the structure of basic (technological) equipment.*

- *Calculation of total labour input of the annual program of all products for flow-line and non-line production. Applying a method of the reduced program for medium-size and small-scale production. Designing in accordance with the reduced program.*
- *Working mode (working time) arrangement of the equipment. Calculation of batch size. Calculation of machine tools quantity and floor space. Workplace organization. Choosing a column grid and width of the main access. Calculating length, width and height of manufacturing divisions. A layout of the basic (technological) equipment at manufacturing divisions.*

Laboratory works (8 hrs):

- *performing a shop floor layout to scale conforming to design norms;*
- *calculating labour input to process the annual programme of all parts in the shop;*
- *calculating equipment quantity and production floor space;*
- *calculating width of production floor space and performing a layout of equipment.*

4.1.3. **Design of auxiliary system**

Structure of auxiliary system. Functions and structure of store, transport, tool management, repair and maintenance, product quality inspection, labour safety and consumer, management and production planning systems. Calculation of equipment, area and quantity of personal.

Types of education activity:

Lectures (8 hrs):

- *Structure of auxiliary system. Functions and classification of storehouse system in mechanical assembly production. Developing technical processes for storehousing. Industrial containers. A subsystem of storing finished articles, semi-finished products and industrial equipment. Rationing warehouse stocks. Calculation of storehouse areas, arrangement of divisions and layout of the storehouse equipment.*
- *Functions and structure of transport system. Classification of transport systems. Transport networks. Intrashop transport system. Determining the size and capacity of goods traffics for semi-finished products and finished articles. Technological process of transportation. Choosing types of load-carrying capacity and quantity of vehicles. Inter-stage transport system in a division. Defining the functions performed by transport system. Choosing facilities for transporting products. Delivery-acceptance sections and their arrangement in relation to transport system. Defining key parametres of transport system for flow-line and non-line production, choosing a scheme and a layout for transport system, its compatibility with storehouse system.*
- *Purpose of tool management system, its functions and structure. Choosing a technique of replacing a cutting tool. Defining the nomenclature and quantity of the tool proceeding from technological processes of manufacturing a product. The scheme of organizing the tool management system. Designing a subsystem of storing and kitting tools and machining attachments. Designing a subsystem of delivering tools and machining*

attachments to the production machinery and disassembling worked-out tools. Designing a subsystem of assembling and adjusting tools and machining attachments. Designing a department of tools restoration. Designing a department of repairing machining attachments. Designing an inspection post. A storehouse of abrasive materials. Organizing divisions and arranging tool management system. Defining content and quantity of staff engaged in tool management system.

- *The purpose of repair and maintenance service, its functions and structure. The basic directions of organizing equipment repair. System of scheduled preventive maintenance and current repair. Designing shop repair division and department of repairing equipment and electronic systems. A subsystem of removing and processing chips. A subsystem of preparing and supplying cutting fluids. A subsystem of electrical supply, compressed air supply, internal environment and clean air environment support. Determining equipment quantity and quantity of staff engaged in repair and maintenance service.*
- *The purpose of product quality inspection system, its functions and structure. Types of inspection in flow-line and non-line production. Test points and inspection posts. Shop express laboratories. Test stations. Calculating floor space. Defining content and quantity of staff engaged in quality inspection system.*
- *The purpose and structure of labour safety system. A subsystem of labour safety. Protection against mechanical devices, chips and cutting liquid. Electrical and fire safety. A subsystem of providing sanitary working conditions. Sanitary norms of air environment, illumination intensity, cleanliness of premises. Protection against vibration and noise. Industrial aesthetics. Main principles of locating facilities for labour safety and consumer services.*
- *The purpose, structure and tasks of management and production planning system. Blank form of day's production schedule for the department. Defining content and quantity of staff engaged in management and production planning service.*

Laboratory works (8 hrs):

- *calculating and lay out of storehouse and transport systems;*
- *designing a tool management system;*
- *calculating and lay out of product quality inspection, labour safety and consumer systems;*
- *designing a management and production planning system.*

4.1.4. **Developing a general layout of the factory and project feasibility study**

Types of education activity:

Lectures (2 hrs):

- *Types and arrangements of buildings for mechanical assembly production. Developing tasks of building, sanitary and power engineering sections. The general layout of a factory (enterprise). A project feasibility study.*

4.2. ***Course structure***

Table 3

Course structure

The section/theme name	Class works (hours)			Self-study (Hours)	Tests	Total
	Lectures	Practice	Labs			
1. The main tasks, principles and sequence of designing	4		4	4	№ 1	12
2. Designing shop floor production	6		8	18	№ 2	32
3. Designing an auxiliary system	8		8	20	№ 3	36
4. Developing the general layout of the enterprise and project economic justification	2			6		8
Total	20		20	48		88

Table 4

Laboratory works

№	Laboratory works	hrs
1	Drawing a shop floor layout not to scale	2
2	Performing a shop floor layout to scale	2
3	Performing a shop floor layout to scale conforming to design norms	2
4	Calculating labour input to process the annual programme of all parts in the shop	2
5	Calculating equipment quantity and production floor space	2
6	Calculating width of production floor space and performing a layout of equipment	2
7	Calculating and lay out of storehouse and transport systems	2
8	Designing a tool management system;	2
9	Calculating and lay out of product quality inspection, labour safety and consumer systems	2
10	Designing a management and production planning system	2
	Total:	**20**

5. Educational technologies

While studying the discipline “Machine shops design” the following educational technologies are used: teamwork, methods of problem-based learning, training on the basis of experience, student’s advanced self-study activity, and project management.

Table 5

Methods and modes of training

Forms / Methods	Lect.	Labs	Practice	Tr*., Mc **	Self-study	Test
IT methods						
Teamwork		+			+	
Case-study						
Role play		+			+	
Methods of problem-based learning.	+					
Methods of experience-	+	+				

based learning						
Advanced self-study	+	+			+	
Projecting					+	
Searching						
Investigating						

* - Training, ** - the Master class

6. Organisation, training and methodological support of students' self-study

6.1. Self-study forms

Student's self-study activity includes the current and creative problem-oriented self-study.

Current self-study is aimed at broadening and improving student's knowledge. Development of practical skills includes:

- Working with lecture material, searching and studying paper and electronic resources in accordance with individual tasks of the course;
- Doing individual hometasks;
- Advanced self-study;
- Studying topics intended for self- study;
- Preparing for laboratory works and tutorials;
- Preparing for credit.

Creative problem-oriented self-study is aimed at developing intellectual abilities, general competences, increasing student's creative potential. This includes:

- Searching, analyzing, structuring and presenting information;
- Researching and participating in scientific conferences, student workshops and competitions;
- Reviewing scientific publications according to pre-determined subject.

6.2. Contents of self-study

6.2.1. The list of scientific problems and areas of research:

- Researching decisions of effectiveness when organizing manufacturing divisions;
- Researching decisions of effectiveness when choosing shop structure and organizational forms of its basic divisions;
- Using computer-aided design (CAD) systems for designing divisions and shops;
- Researching selection criteria of an optimum variant of the project;
- Researching modern directions for choosing the structure of the production machinery for flow-line and non-line production;
- Researching tendencies for calculating total labour input of the annual program of all products for flow-line and non-line production;
- Researching tendencies of designing storehouse service;
- Researching tendencies of designing transport service;
- Researching tendencies of designing tool management service;
- Researching tendencies of designing repair and maintenance service;

- Researching tendencies of designing quality inspection service;
- Researching tendencies of designing labour safety service;
- Researching tendencies of designing management and production planning services;
- Researching tendencies of designing the general layout of an enterprise;

6.2.2. Individual tasks:
- Designing a machining division with high economic self-reliance;
- Designing an assembling division with high economic self-reliance.

6.2.3. Self-study topics:
- Requirements of environment protection and waste recycling;
- Use of computer-aided design (CAD) systems for designing divisions and shops;
- The content of technical, organizational, economic and social problems solved at designing;
- Main design principles;
- The workplace organization;
- Calculation of the storehouse area;
- Technological processes of transportation;
- Developing tasks for the building section;
- Developing tasks for the sanitary section;
- Developing tasks for the power engineering section;
- Project economic justification.

6.3. Self-study check

The result assessment of student's self-study is organized as integration of two forms: self-check and check by teachers. The last is carried out by giving written tests on the main sections of the discipline; having oral tests during laboratory practicals and tutorials; defending reports on laboratory and practical works, home and individual tasks, as well as reports on creative self-study work.

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 6

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

Everyday and progress assessment (examples)

Sections 1 – 2

1. What is a workshop?
2. What is a production floor?
3. What is a production cycle?
4. What are the main stages of production?
5. What is flow-line production?
6. What is a batch?
7. What is the total floor space of a workshop?

Section 3

1. Enumerate the sequence of designing machine shops.
2. What problems should be solved when designing machine shops?
3. Enumerate the tasks which are solved at pre-design stage.
4. What are the main sections of the machine shop design?

Section 4

1. What problems are solved by a CAD system when designing divisions and shops?
2. What is the structure of providing CAD system?
3. Draw the CAD system block diagram.
4. What are the main sections of the machine shop design?
5. What is the basic difference between a CAD system and a traditional design system?

Sections 5 – 6

1. What principles is it necessary to adhere when designing shops?
2. Describe how to determine a type of production.
3. Describe each type of production.
4. What are the ways to automate manufacture?
5. Draw a production efficiency graph depending on manufacturing automation. Specify the type of the equipment used.
6. Enumerate construction and installation measures in order to increase flexibility of production.

Section 7

1. What is the working mode?
2. What is the actual time arrangement? What are the norms for different quantity of working shift?
3. What is the annual actual time arrangement of the worker for 41 hrs working week?
4. Does the annual actual time arrangement of the worker depend on the quantity of working shift?

Sections 8 – 9

1. What does the batch size influence on?
2. Describe how to calculate floor-to-floor time for one operation (process)?
3. Describe how to calculate total floor-to-floor time for operation (process)?
4. What is plant schedule?
5. Enumerate advantages and disadvantages of labour intensity calculation according to the method of the reduced program.

Section 10

1. Describe how to calculate the demanded amount of the machine tools in the shop.
2. What is technological process synchronization? What ways of it are there?
3. What is the operating ratio of the given type of the equipment? Describe how to calculate it.
4. Describe how to calculate the demanded amount of one type (j-type) of the machine tools in the shop.

Section 16

1. What does the auxiliary system consist of?
2. Describe the types of storehouses according to their intended purpose.
3. Describe the types of the transport service according to their intended purpose.

Section 17

1. What configurations and types of shop buildings are there? What are they intended for and what limitations are there?
2. What are the main principles influencing on the selection of a shop arrangement?
3. What are the basic technical-and-economic indexes characterizing the general work program of the factory?

Intermediate examination (examples)

Block of questions №1

1. What are the main stages of production?
2. What is flow-line production?
3. What is a batch?
4. What is the total area of a workshop?
5. What is direct labour?
6. What are the engineering, technical and office personnel?
7. What is junior labour?
8. What is the difference between shop arrangement and shop layout?
9. What is ‘column space’ and ‘width of span’?

Block of questions №2

10. Enumerate the sequence of designing machine shops.
11. What problems should be solved when designing machine shops?
12. What are the raw data for a machine shop design when building a new shop and modernizing an existing one?
13. Enumerate the tasks which are solved at pre-design stage.
14. What does the basic section of the machine shop design contain?
15. What does working design documentation include?
16. What does the technical design assignment include?
17. What problems are solved by a CAD system when designing divisions and shops?

Block of questions №3

18. Describe how to calculate floor space.
19. What principles is it necessary to adhere when designing shops?

20. What are the ways to automate manufacture?
21. What are the FMS, RTC, FMM?
22. What are a flexible transfer line and a manufacturing cell?
23. Draw a production efficiency graph depending on manufacturing automation. Specify the type of the equipment used.
24. What are the main criteria of choosing the equipment configuration?

Final examination (examples)

Version №1

1. What are the main stages of production?
2. What principles is it necessary to adhere when designing shops?
3. Describe how to calculate the demanded amount of one type (j-type) of the machine tools in the shop.
4. What does the auxiliary system consist of?

Version №2

1. What are the raw data for a machine shop design when building a new shop and modernizing an existing one?
2. What is the difference between shop arrangement and shop layout?
3. Describe the types of the transport service according to their intended purpose.
4. What is technological process synchronization? What ways of it are there?

Version №3

1. Enumerate construction and installation measures in order to increase flexibility of production.
2. What is the difference between shop arrangement and shop layout?
3. The purpose, structure and tasks of management and production planning system.
4. Enumerate the tasks which are solved at pre-design stage.

6.4. References for self-study

Main sources:

1. Kozlov V.N., Pichugova I.L., Machine shops design: study aid / Tomsk Polytechnic University. – Tomsk: TPU Publishing House, 2013. – 132 p.
2. Methodological instructions for self-study designed for students enrolled in the Bachelor Degree program 150700 “Mechanical engineering” / developed by V.N. Kozlov. – Tomsk: Tomsk Polytechnic University Publishing House, 2012. – 28 p.

Additional sources:

3. Вороненко В.П. Проектирование механосборочных цехов: учебник\ В.П. Вороненко, Ю.М. Соломенцев, А.Г. Схиртладзе. 2-е издание, стер. – М.: Дрофа, 2006. – 380 с.: ил..
4. Козлов В.Н. Проектирование механосборочных цехов. Учебное пособие.– Томск, Изд. ТПУ, 2009 г. – 144 с.
5. Петкау Э.П., Матвеев В.С., Журавлёв В.А. Проектирование

машиностроительного производства: учебное пособие – Томск, Изд. ТПУ, 2002 г. – 199 с. : ил.
6. Проектирование автоматизированных участков и цехов\ Под. ред. Ю.М. Соломенцева. – 2-е изд., испр. – М.: Высшая школа, 2000. – 272 с. : ил.
7. Королёва Н.И. Организация производства на предприятии: учебное пособие. – Томск, Изд. ТПУ, 2002 г. – 156 с.

6.4.2. *Internet resources:*

1. http://e-le.lcg.tpu.ru/public/OTM_0771/index.html

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

Main sources:

1. Kozlov V.N., Pichugova I.L., Machine shops design: study aid / Tomsk Polytechnic University. – Tomsk: TPU Publishing House, 2013. – 132 p.
2. Проектирование механосборочных цехов. Рабочая программа, контр. задания и метод. указания для студентов спец. 151001 «Технология машиностроения» ИДО/ Сост. В.Н. Козлов. – Томск, Изд. ТПУ, 2006 г. – 23 с.

Additional sources:

3. Вороненко В.П. Проектирование механосборочных цехов: учебник\ В.П. Вороненко, Ю.М. Соломенцев, А.Г. Схиртладзе. 2-е издание, стер. – М.: Дрофа, 2006. – 380 с.: ил.
4. Козлов В.Н. Проектирование механосборочных цехов. Учебное пособие.– Томск, Изд. ТПУ, 2009 г. – 144 с.
5. Петкау Э.П., Матвеев В.С., Журавлёв В.А. Проектирование машиностроительного производства: учебное пособие – Томск, Изд. ТПУ, 2002 г. – 199 с. : ил.
6. Проектирование автоматизированных участков и цехов\ Под. ред. Ю.М. Соломенцева. – 2-е изд., испр. – М.: Высшая школа, 2000. – 272 с. : ил.
7. Королёва Н.И. Организация производства на предприятии: учебное пособие. – Томск, Изд. ТПУ, 2002 г. – 156 с.

Internet resources:

8. http://e-le.lcg.tpu.ru/public/OTM_0771/index.html

10. Material support of the discipline

Laboratory works take place in the Laboratory of cutting metals, the Laboratory of mechanical engineering technology and in the interactive classroom with NC machine tools belonging to Automated Engineering Technology department, Institute of Cybernetics.

Laboratories of cutting metals and mechanical engineering technology are equipped with a lathe 1K62, surface grinder 3G71P, the NC lathe 16K20F3, surface roughness measurement instrument MIS-11 and tools for measuring linear and angular dimensions.

The interactive classroom with NC machine tools by firms "ARINSTEIN" (Germany) contains a lathe EMCO CONCEPT TURN 55 and EMCO CONCEPT MILL 155 milling processing centre with changeable NC systems (Fanuc and Siemens) and six workplaces for students with changeable NC panels and computers.

This program is made in accordance with TPU Standards and Federal State Educational Standards (FSES) requirements in the study major of 150700 "Mechanical engineering".

This program was approved during Automated Engineering Technology department meeting (protocol № 3 from «24» 10. 2013 г.).

Author: _____ Kozlov V.N.

Reviewer: _____ Arlyapov A. Yu.

11. Study schedule

According to the study schedule an intermediate test is taken once a month during the term by assessing the quality of mastering theoretical material (answering questions) and the results of practical activities (solving tasks, doing tasks, solving problems).

Intermediate attestation (examination, credit test) is taken at the end of the term by having marks. The total rating is defined by summing results of intermediate test marks during the term and marks of intermediate attestation at the end of the term in accordance with the results of an examination or a credit test. The maximum rating corresponds to 100 points (60 – intermediate tests during the term, 40 – intermediate attestation at the end of the term). The term schedule of the discipline is shown in Tab. 3.

Table 3

Term schedule

Weeks	Schedule												
	Theoretical material				Practice								Total
	Topic	Lectures (22 hrs)	Testing	Points	Laboratory works (22 hrs)	Points	Practice (10 hrs)	Points	Boundary check (individual hometasks, tests, reports, etc)	Points	Problem-oriented tasks	Points	
1	Main goals, principles and sequence of designing, 4 hrs	1. Content and stages of manufacturing processes. Main principles of organizing manufacturing divisions.			Drawing a shop floor layout not to scale	1			Giving individual hometask				1
2		2. The content of the problems solved at design. Main design principles.			Performing a shop floor layout to scale	1			Test №1	4			5
Check point №1 in total													**6**
3	Design of shop floor production, 6 hrs	3. Calculation of labour input of the annual program for all products			Analyzing a shop floor layout	1							1
4		4. Calculation of required quantity of equipment and floor space. The workplace organization.			Performing a shop floor layout to scale conforming to design norms	1							1
5		5. A layout of industrial equipment in divisions.			Performing a shop floor layout to scale conforming to design norms *(continuation)*	1			Test №2	10			11
Check point № 2 in total													**13**

6	Design of auxiliary system, 10 hrs	6. Structure of auxiliary system. Storehouse and transport services.			Calculating labour input to process the annual program of all parts in the shop	1							1
7		7. Tool management service			Calculating labour input to process the annual program... *(continuation)*	1							1
8		8. Repair and maintenance service			Calculating equipment quantity and production floor space	1							1
9		9. Quality inspection and consumer service			Designing tool management system	1							1
10		10. Production management service			Designing tool management system *(continuation)*	1			Test №3	12			13
Check point № 3 in total													**17**
11	General layout of the enterprise and project economic justification, 2 hrs	11. Developing the enterprise general layout and a project economic justification			Designing storehouse and transport services	1			Test №4	3			4
12													
Check point № 4 in total													**4**
Individual hometasks													**20**
Total intermediate points													**60**
Credit test													40
Points in total (all course)													**100**