

MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE
Sumy State University

APPROVE
Head of the admissions
committee



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2024

PROGRAM
of the professional exam during admission to study
for the master's degree in specialties
131 "Applied Mechanics" and 133 "Industrial Mechanical Engineering"

1 GENERAL TERMS

Conducting a professional exam during admission to the master's degree in the specialties 131 "Applied Mechanics" and 133 "Industrial Mechanical Engineering" is aimed at assessing the readiness of the entrant to obtain the "master's" degree in the specialties 131 "Applied Mechanics" and 133 "Industrial Mechanical Engineering" for the further possibility of training a specialist for the master's degree in specialties 131 "Applied Mechanics" and 133 "Industrial Mechanical Engineering" taking into account the requirements of future professional and scientific activity and the requirements for the content of education and training from the state and individual customers of specialists.

The professional exam is conducted in written test form. The structure of the ticket includes 40 questions.

The test contains questions from the following sections of the bachelor's degree curriculum, specialties 131 "Applied mechanics" and 133 "Industrial mechanical engineering": "Interchangeability, standardization and technical measurements", "Technological bases of mechanical engineering".

The form of the professional exam is a written test.

The time is allocated for the professional exam –
2 academic hours (80 minutes).

2 ANNOTATIONS AND TYPICAL QUESTIONS FROM SECTIONS, WHAT IS TAKEN FOR THE PROFESSIONAL EXAMINATION

2.1 «Interchangeability, standardization and technical measurements»

Basic concepts of interchangeability.

Development of interchangeability. Types of interchangeability. The concept of dimensions, conjugation, tolerances and fits. Nominal and actual sizes. Determination of limit deviations and dimensions. The concept of tolerance. Graphic representation of tolerance fields. Determination of fit. Fit with a clearance, tension, and transitional.

Interchangeability of smooth cylindrical connections.

The unified system of tolerances and fits (USTF) and its connection with the international system (ISO). Tolerance unit, qualities, diameter intervals. The main deviations. Hole system and shaft system. Better tolerance fields. Fits with a clearance, with tension, transitional, their application. Calculation and selection of fits. Conventional designation of tolerance and fit fields on drawings. Limit deviations of dimensions with unspecified tolerances.

Control of smooth cylindrical parts by calibers.

Concept of control of details. Definition of caliber. Classification of calibers. Caliber designs for the control of holes and shafts. Caliber requirements. Determination of the limit sizes of calibers. Tolerance fields.

Tolerances and fits of rolling bearings.

Design parameters of rolling bearings. Accuracy classes of rolling bearings. Tolerance fields of the shaft and housing seats for rolling bearings. The choice of fits depends on the type of load, the mode of operation, and the accuracy class of the bearing. The conventional designation of rolling bearings fits on the drawings.

Interchangeability, standardization and control methods of keyed and splined joints.

Basic operational requirements for keyed and splined joints. Tolerances and fits of splined joints with prismatic splines. Methods of centering spline joints. Tolerances and fits of splined joints with a straight profile. Tolerances and fits of splined joints. Tolerances of spline joints with an involute profile. Designation of tolerances and fits of splined joints on the drawings. Methods of controlling keyed and splined joints. Complex calibers for splined joints.

Interchangeability, standardization and control methods of threaded joints.

Classification of threads by operational purpose. The main parameters of the thread. The principle of thread interchangeability. Limiting contours of the thread. Deviation of step and profile angle and their diametrical compensation. System of tolerances and fits of metric threads. The average diameter of the cutting. Degree of accuracy and classes of cutting accuracy. Cutting tolerances. Fits with clearance and tension. Determination of accuracy and fit of metric threads on drawings. Methods and means of controlling the accuracy of cylindrical threads.

Tolerances of shape and location of surfaces. Surface roughness.

Deviation of the shape of cylindrical, flat surfaces and the shape of a given profile. Deviation of the location of surfaces. Total deviations and tolerances of the shape and location of surfaces. Levels of geometric accuracy. The basic rules for marking tolerances of shape and location on the drawing. Basic parameters of surface roughness assessment. Conventional notation of roughness on drawings.

Dimensional chains. Methods of calculating dimensional chains.

Theoretical and probabilistic method of calculating dimensional chains. The method of group interchangeability. Adjustment method.

2.2 «Technological bases of mechanical engineering»

Basic concepts and definitions.

Mechanical engineering and its influence on other branches of the national economy. The main stages of the development of mechanical engineering and the contribution of domestic and foreign scientists to its achievements. The machine, service purpose, assembly unit, part, complex, and kit. Technological scheme of assembly of products and rules of its construction. Production types, their definition and characteristics. Organizational forms of work for different production types. The structure of technical preparation of production. The structure of production and technological processes. Classification of technological processes and forms of technological documentation.

Basics of basing products.

Classification of parts surfaces. Basics of basing products. Classification of bases. Theoretical schemes of basing workpieces of different classes. Typical schemes of basing workpieces during mechanical processing. Rules for selecting bases.

Accuracy and methods of achieving it in the manufacture of products.

Accuracy and quality indicators for engineering products. Economical and achievable accuracy. Methods of achieving accuracy during mechanical processing and assembly. The main factors affecting the accuracy of mechanical processing of machine parts. Installation errors, geometric errors of machine tools, errors of setting up the machine tool, errors due to tool wear, temperature and elastic deformations of T-system elements. Surface roughness and methods of its assessment. Effect of surface quality on operational properties of parts. Technological methods of improving the quality of surfaces.

Design basics of technological processes of mechanical processing of workpieces.

Initial information for designing technological processes. Basic principles and sequence of designing technological processes. Determination of the type of production, release rate, and launch batch. Working out the design of the product for manufacturability. Selection of the starting workpiece. Determination of allowances by the experimental and statistical method. The main principles of forming the workpiece processing route. Standardization of the execution time of a technological operation. Issuance of maps of technological documentation. Technical and economic justification of the variant of the technological process. Typical technological processes of processing parts classes - the shaft, sleeve, housing, and gear.

3 STRUCTURE OF EXAMINATION TASKS

The version of the test task contains 40 theoretical and practical questions from sections that form general professional competencies in the specialty.

Number of answer options – 4.

Correct answers – 1.

Appendix A of this program shows a typical version of the professional examination task.

A sample answer sheet is provided in Appendix B of this application.

4 EVALUATION CRITERIA

General requirements.

The commission evaluates the entrant's written answers to test tasks on a 100-200 point scale. Entrants who score less than 100 points receive an "unsatisfactory" score and are not allowed further participation in the competitive selection. Entrants who scored 100 or more points are allowed to participate in the competitive selection.

To receive a positive score on the exam, the entrant needs to pass the minimum acceptable test threshold at the level of 0.32 or 32% of the total number of test points.

Test points are awarded for each correct answer to the task, 0 points are awarded for an incorrect answer. The obtained test scores for the exam are converted into a 100-200 point scale (with rounding to the nearest whole, according to the rules of mathematical rounding) according to the following algorithm:

$$O = O_{\min} + k \cdot (N - r \cdot T),$$

where

- O – the exam score on a scale of 100-200 points;
- O_{\min} – the minimum score from the exam on a scale of 100-200 points, at which the entrant is allowed to participate in the competitive selection;
- k – the coefficient of transfer of test scores to a scale of 100-200 points, while:

$$k = 100 / (T \cdot (1 - r)),$$

- r – the minimum acceptable test threshold with an accuracy of up to 0.01, which is set in the range from 0 to 1, but not less than 0.10;
- T – the total number of test points that the entrant can receive during the entrance test;
- N – the number of test points that the entrant received during the entrance test.

Provided that the number of test points that the entrant received during the exam (N) is "0", then the entrant receives an "unsatisfactory" score and is not allowed to further participate in the competitive selection.

Accrual of test points.

For each correct answer to a test question, 8 test points are awarded. Incorrect answer - 0 points.

The total number of test points (T) an entrant can get during the exam is 200.

The number of test points for the exam (N) is calculated as the sum of test points, excluding test points removed for corrections in the answer sheet (if provided by the program).

Policy on corrections.

For every five corrections in the test answer sheet, 1 test point is deducted from the total number of test points (T) the entrant can obtain in the exam.

5 LIST OF RECOMMENDED LITERATURE

5.1 «Interchangeability, standardization and technical measurements»

1. Взаємозамінність, основи стандартизації та технічних вимірювань : підручник / Г. О. Іванов, В. С. Шебанін, Д. В. Бабенко, П. М. Полянський ; за ред. Г. О. Іванова і В. С. Шебаніна. вид. перероб. і доп. Миколаїв : МНАУ, 2016. 412 с.
2. Допуски, посадки та технічні вимірювання. Практикум. Частина 1 : навч. посібн. / Ю. І. Адаменко, О. М. Герасимчук, С. В. Майданюк, Н. В. Мініцька та ін. Івано-Франківськ: Симфонія форте, 2016. 164 с.
3. Допуски, посадки та технічні вимірювання. Практикум. Частина 2 : навч. посібн. / Ю. І. Адаменко, О. М. Герасимчук, С. В. Майданюк, Н. В. Мініцька та ін. Івано-Франківськ: Симфонія форте, 2016. 188 с.

5.2 «Technological bases of mechanical engineering»

1. Технологічні основи машинобудування : підручник для студ. спеціальностей 131 «Прикладна механіка», 133 «Галузеве машинобудування» / С. С. Добрянський, Ю. М. Малафеев; КПІ ім. Ігоря Сікорського. Київ : КПІ ім. Ігоря Сікорського, 2020. 379 с.
2. Технологія машинобудування : навч. посіб. / Є. О. Горбатюк, М. П. Мазур, А. С. Зенкін, В. Д. Каразей. Львів : Новий Світ-2000, 2012. 358 с.
3. Захаркін, О. У. Технологічні основи машинобудування (основні способи обробки поверхонь та технологічні обробляючі системи для їх реалізації) : навч. посіб. / О. У. Захаркін. Суми : СумДУ, 2011. 137 с.

Approved on the admissions committee meeting,

the protocol № 11 from 08.04.2024

Responsible secretary
of the admissions committee



Ihor ROY

Head of the professional
attestation commission



Artem YEVTUKHOV

Appendix A

SUMY STATE UNIVERSITY

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_____ 2024

EXAMINATION TASK

**professional exam during admission to study
to obtain a master's degree in specialties**

131 "Applied Mechanics" and 133 "Industrial Mechanical Engineering"

Variant № _____

1. Two or more products that are not connected at the enterprise by assembly operations but are a set that has a general operational purpose of an auxiliary nature (a set of keys, a set of gaskets, spare parts supplied with the enterprise's products) are

| | | | |
|----------------|---------|--------------------|-------------|
| A) all listed. | B) kit. | C) assembly units. | D) complex. |
|----------------|---------|--------------------|-------------|

2. When drawing up the technological diagram of the product assembly, in which place is the designation of the basic part placed?

| |
|---|
| A) above the horizontal line. |
| B) no significant importance. |
| C) at the beginning of the horizontal line. |
| D) under a horizontal line. |

3. What qualifications do machine tool workers and adjusters mostly work in mass production?

| |
|--|
| A) low-skilled machine tool workers, highly skilled adjusters. |
| B) middle-skilled machine tool workers and adjusters. |
| C) machine tool workers and adjusters of all the specified qualifications. |
| D) highly qualified machine tool workers and adjusters. |

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Head of the professional
attestation commission


(signature)

Artem YEVTUKHOV

Appendix B
SUMY STATE UNIVERSITY

Code _____

ANSWER SHEET
professional exam during admission to study
to obtain a master's degree in specialties
131 "Applied Mechanics" and 133 "Industrial Mechanical Engineering"

Variant № _____

| № ques. | A | B | C | D | № ques. | A | B | C | D | № ques. | A | B | C | D |
|---------|---|---|---|---|---------|---|---|---|---|---------|---|---|---|---|
| 1 | | | | | 16 | | | | | 31 | | | | |
| 2 | | | | | 17 | | | | | 32 | | | | |
| 3 | | | | | 18 | | | | | 33 | | | | |
| 4 | | | | | 19 | | | | | 34 | | | | |
| 5 | | | | | 20 | | | | | 35 | | | | |
| 6 | | | | | 21 | | | | | 36 | | | | |
| 7 | | | | | 22 | | | | | 37 | | | | |
| 8 | | | | | 23 | | | | | 38 | | | | |
| 9 | | | | | 24 | | | | | 39 | | | | |
| 10 | | | | | 25 | | | | | 40 | | | | |
| 11 | | | | | 26 | | | | | | | | | |
| 12 | | | | | 27 | | | | | | | | | |
| 13 | | | | | 28 | | | | | | | | | |
| 14 | | | | | 29 | | | | | | | | | |
| 15 | | | | | 30 | | | | | | | | | |

WARNING!!! Tasks have several answer options, among which only one is correct. Choose the option that you think is correct and mark it as shown in the sample. **The number of corrections affects the overall work score!**

| | | | |
|-------------------------------------|--------------------------|--------------------------|--------------------------|
| A | B | C | D |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

Number of correct answers – _____ :

The number of points for them – _____ :

Number of corrections – _____ :

Deduct points for corrections – _____ :

Total points including withdrawals – _____
(in number and in writing)

Head of commission _____
(signature) (surname, initials)

Members of the commission _____
(signature) (surname, initials)

_____ (signature) (surname, initials)