

Ministry of Science and Higher Education of the Russian Federation  
 Federal State Budgetary Educational Institution of Higher Education  
**Perm National Research Polytechnic University**

**APPROVED BY**

Pro-rector for Academic Affairs

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20 21

**ACADEMIC COURSE WORKING PROGRAM**

**Academic course:** Engineering geometry and computation graphics  
 (Name)

**Form of education:** Full-time  
 (Full-time /full-time – correspondence/correspondence)

**Level of higher education:** Bachelor's program  
 (Bachelor's program/specialist program/  
 Master's program)

**Workload in hours (in credits):** 144 (4)  
 (Hours (CU))

**Training program (degree):** 21.03.01 Oil and Gas Engineering  
 (Code and denomination of degree)

**Direction:** Oil and Gas Engineering  
 (Title of curriculum)

## 1. GENERAL PROVISIONS

### 1.1. GOALS AND OBJECTIVES OF THE COURSE

The goal of the course is to prepare graduates who are proficient in modern methods of geometric modeling, capable of using information technologies, applied software tools in the development of working design and technical documentation.

### 1.2. STUDIED OBJECTS OF THE COURSE

Theoretical foundation of constructing drawings of objects on a plane; the basics of geometry construction and the structure of design documentation; solid modeling programs (CAD), e.g. Solid Edge

### 1.3. STARTING CONDITIONS

Unstipulated

## 2. PLANNED RESULTS OF THE COURSE TRAINING

| Competence | Indicator's Index     | Planned Results of the Course Training (to know, to be able, to master)   | Indicator of Attaining Competence which the planned results of training are correlated with  | Means of Assessment |
|------------|-----------------------|---|--|---------------------|
| 1          | 2                     | 3   | 4  | 5                   |
| GPC-7      | IA-1 <sub>gpc-7</sub> | <b>To know</b> the content of engineering documentation models connected with professional activity; the theoretical foundation of constructing drawings of objects on a plane; the techniques for determining the forms and dimensions of objects  | <b>Knows</b> the content of engineering documentation models connected with professional activity.   | Progress check      |
| GPC-7      | IA-2 <sub>gpc-7</sub> | <b>To be able to</b> use the basic types and content of engineering documentation models connected with professional activity; to demonstrate the ability to generalize information and put it into the blanks of models in accordance with active standards; to solve technical design problems using traditional tools or CAD | <b>Is able to</b> use the basic types and content of engineering documentation models connected with professional activity; demonstrates the ability to generalize information and put it into the blanks of models in accordance with active standards. | Case-task           |

| 1     | 2          | 3  | 4   | 5            |
|-------|------------|--|---|--------------|
| GPC-7 | IA-3.gpc-7 | To master the skills of reporting, making reviews, references, requests and etc. relying on real situation; of performing projects in 3D and intellectual capability of space perception; of handling the software for geometric modeling and visualization. | Masters the skills of reporting, making reviews, references, requests and etc. relying on real situation. | Grading test |

### 3. FULL TIME AND FORMS OF ACADEMIC WORK

| Form of academic work   | Hours in all | Distribution in hours according to semesters |    |            |
|---|--------------|--|----|------------|
|   |              | Number of semester                           |    |            |
|   |              | I  | II | III        |
| 1. Holding classes (including results monitoring) in the form:<br>1.1.Contact classwork, including: |              |  |    |            |
| – lectures (L)  | 18           |  |    | 18         |
| – laboratory work (LW)  | 16           |  |    | 16         |
| – practice, seminars and/or other seminar-type work (PW)  | 25           |  |    | 25         |
| – control of self-work (CSW)  | 4            |  |    | 4          |
| – test  |              |  |    |            |
| 1.2. Students' self-work (SSW)  | 81           |  |    | 81         |
| 2. Intermediate attestation   |              |  |    |            |
| Grading test  |              |  |    |            |
| <b>Workload in hours</b>  | <b>144</b>   |  |    | <b>144</b> |

### 4. COURSE OUTLINE

| Name of the units with the course outline  | Full time of classroom activity in hours according to the forms |    |    | Full time of extracurricular work in hours according to the forms |
|--|---|----|----|---|
|  | L   | LW | PW | SSW   |
|  | 1   | 2  | 3  | 4   |
| <b>3rd semester</b>  |   |    |    |   |
| <b>Basic Geometrical Definitions.</b> A straight line and a point. A curved and a broken line. Angles, plane figures: triangles, quadrilaterals, polygons, circles. Surfaces. Geometrical problems.  | 2   | 4  |    | 8   |
| <b>Projections.</b> Types of projections. The multiview drawing of a point and a straight line. The transformation of projections. The true length of a line and its angles of inclination. The projections and positions of the given plane relative to the planes of projections. The multiview drawing of geometrical bodies and curved surfaces. Projections of points and lines on their surfaces. Intersection of planes and surfaces. | 10  | 4  | 10 | 20  |



| 1  | 2  | 3  | 4  | 5  |
|--|----|----|----|----|
| <b>Design Solid Models.</b> First angle projection method. Technical documentation. Principal Views. Types of cross-sections. Basic dimensioning rules. Geometric properties of a solid. 3D modeling. A basic solid modeling process: sketch a section and extrusion. Visualization of the internal or hidden features of a solid model. | 6  | 8  | 8  | 26 |
| <b>Assembly Drawings.</b> Standardization of threads. Geometric construction. Threads and standard fasteners. Fastener Dimension Tables. 3D CAD fastener drawings.   |    |    | 7  | 27 |
| Total with regard to semester  | 18 | 16 | 25 | 81 |
| Total with regard to the course  | 18 | 16 | 25 | 81 |

### Topics of exemplary practical work

| Sl. № | Topic of practical (seminar) work  |
|-------|--|
| 1     | Types of projections. The multiview drawing of a point.  |
| 2     | The straight line. The multiview drawing of a straight line. The positions of straight lines relative to the planes of projections. Relative position of points and lines, two lines. The transformation of projections. |
| 3     | Projecting planes. Oblique planes. Level lines in a plane.   |
| 4     | Relative position of lines and planes, two planes.   |
| 5     | Representations of geometrical bodies and surfaces. Curved surfaces. Projections of points and lines on the surfaces.  |
| 6     | Intersection of planes and surfaces. Plane section of polyhedrons and curved surfaces. Conic sections.   |
| 7     | Standard of technical drawing. Orthographic projection. First angle projection method. Principal views.  |
| 8     | Different types of sectional views. Full sections and half sections. Section lining.   |
| 9     | An offset section. Broken-out section view. Removed section.   |
| 10    | Machine screws. Simplified representation. External and internal thread.   |
| 11    | Stainless machine screws. The bolts, the nuts and the washers.   |
| 12    | An assembly drawing.   |
|       | Grading test   |

### Topics of exemplary laboratory practice

| Sl. № | Topic of laboratory work   |
|-------|--|
| 1     | Solid Edge user interface basics. Sketching. The geometrical primitives. |
| 2     | Drawing commands. Sketch geometric relationships. Dimensioning commands. |
| 3     | The engineering sketches. 2D parametric constraints.                     |
| 4     | Solid modeling. The basic principles of 3d modeling. Coordinate systems. |
| 5     | Feature-based modeling workflow. Constructive solid geometry.            |
| 6     | Parametric 3d modeling techniques. Modeling assemblies.                  |
| 7     | Parametric 3d modeling techniques. Modeling assemblies.                  |
| 8     | Grading test   |

## 5. ORGANIZATIONAL AND PEDAGOGICAL CONDITIONS

### 5.1. EDUCATIONAL TECHNOLOGIES USED FOR COMPETENCES FORMATION

The integrative educational discipline "Engineering Geometry and Computation Graphics" implements within the foundation part of the higher educational specialized program "Construction". Graphic training is the first professionally oriented discipline at a technical university. Within the framework of subject training, it is important to create a learning environment that is close to professional.

Holding lectures in the discipline is based on the active method of training in the process of which students are not passive but active participants of the lesson answering questions of the teacher. Teacher's questions are aimed at activating the process of learning material as well as at the development of logical thinking. The questions stimulating associative thinking and connecting new material with the previous one are identified by the teacher in advance.

Practical lessons are held by realization of the method based on active training: problem areas are determined, groups are formed. The following aims are pursued in the process of practical education: use of definite disciplines knowledge and creative methods in solving problems and decision-making; students' skill-building of teamwork, interpersonal communication and development of leadership skills; consolidation of the basic theoretical knowledge.

Laboratory classes are based on an interactive learning method in which students communicate not only with the teacher but also with each other. At the same time, students' activity in the learning process dominates. The teacher's place in interactive classes is reduced to orienting students' activities to achievement of the goals of studies.

Interactive lectures, group discussions, role-playing games, training sessions, and analysis of situations and simulation models are used in academic studies

The course project, carried out as part of the out-of-class independent work of students, allows you to consolidate design skills, gain experience in designing specific technical objects, and improve the skills of graphic design of design results..

### 5.2. STUDENTS' MANUAL FOR THE COURSE STUDY

Learning the course students are recommended to fulfill the following positions:

1. Learning of the discipline should be done systematically.
2. After learning one of the course unit with the help of the text-book or lecture notes it is recommended to reproduce in memory the basic terms, definitions, notions of the unit.



3. Special attention should be paid to the reports on practical studies, laboratory works and individual complex tasks for self-work.

4. The topic of questions studied individually is given by the teacher at the lectures. Also the teacher refers to the literary resources (first of all, to the newly published in periodicals) in order the students understand the problems touched on the lectures in detail.

## 6. LIST OF TEACHING MATERIALS AND INFORMATION SUPPLY FOR STUDENTS' SELF WORK IN THE DISCIPLINE

### 6.1. PAPER-BASED COURSEWARE

| Sl.No   | Bibliographic entry<br>(author, title, mode of publication, place, publishing house,<br>year of publication, number of pages )                                  | Number<br>of copies in<br>the library |
|---|---|---------------------------------------|
| <b>1. Basic literature</b>  |   |                                       |
| 1   | Earle J. H. Engineering Design Graphics. 6th ed Reading, Massach : Addison-Vesley Publ. Co, 1990. 849 p.  | 1                                     |
| 2   | Earle J. H. Engineering Design Graphics. 5th ed Reading, Massachusetts : Addison-Vesley Publ. Co, 1987. 846 p.  | 1                                     |
| 3   | Rajaraman A. Computer Graphics for Engineers. Oxford : Alpha Science Intern. Ltd, 2009. 116 p.  | 1                                     |
| <b>2. Additional literature</b>                                   |   |                                       |
| <b>2.1. Educational and scientific literature</b>                 |   |                                       |
| 1   | Bertoline et al. Fundamentals of Graphics Communication. 6e.  |                                       |
| 2   | Goetsch D. L., Nelson J. A. Technical Drawing and Design. New York : Delmar Publ., 1986. 751 p.   | 1                                     |
| 3   | Evans P. Extraordinary Graphics For Unusual Surface : Making the Most of Hard-to-Design Spaces. Gloucester, Massachusetts : Rockport Publ., 2002. 190 p.        | 1                                     |
| 4   | Cullen C.D., Haller L. Design Secrets: Products 2 : 50 Real-Life Projects Uncovered. Gloucester, Massachusetts : Rockport Publ., 2004. 208 p.                   | 1                                     |
| 5   | Gambhir M. L. Stability Analysis and Design of Structures. Berlin : Springer, 2004. 535 p.  | 1                                     |
| 6   | Communicate: Independent British Graphic Design since the Sixties / Crowley D., Macdonald N., O'Reilly J., Poynor R. London : Laurence King Publ., 2004. 255 p. | 1                                     |
| 7   | Peters. R.L. Worldwide Identity: inspired design from forty countries : [Album]. Gloucester, Massachusetts : Rockport Publ., 2005. 256 p.                       | 1                                     |
| 8   | Glendinning E. H., Glendinning N. Oxford English for Electrical and Mechanical Engineering : Student's Book. Oxford : Oxford Univ. Press, 2010. 190 p.          | 50                                    |
| <b>2.2. Standardized and Technical literature</b>                 |   |                                       |
|   |   |                                       |
| <b>4. Teaching and learning materials for students' self-work</b> |   |                                       |
|   |   |                                       |

## 6.2. ELECTRONIC COURSEWARE

| <b>Kind of literature</b> | <b>Name of training tool</b>  | <b>Reference to information resource</b>   | <b>Accessibility of EBN (Internet/local net; authorized free access)</b> |
|---------------------------|---|--|--|
| Additional literature     | Digital control engineering : analysis and design / New York : Elsevier, 2009.  | URL: <a href="https://elib.pstu.ru/Record/RUPNRPUElib4243">https://elib.pstu.ru/Record/RUPNRPUElib4243</a>             | authorized free access   |
| Additional literature     | Vostrikova S. Graphic Design Lexicon. M., 2012.   | URL: <a href="https://elib.pstu.ru/Record/lan73833">https://elib.pstu.ru/Record/lan73833</a>                           | authorized free access   |
| Additional literature     | Vadim A. Z., Lubomir V. D., Jaroslav N. Numerical Optimization of Regulators for Automatic Control System : textbook for higher education. Novosibirsk: NSTU, 2019. | URL: <a href="https://elib.pstu.ru/Record/lanRU-LAN-BOOK-152223">https://elib.pstu.ru/Record/lanRU-LAN-BOOK-152223</a> | authorized free access   |

## 6.3. LICENSE AND FREE DISTRIBUTED SOFTWARE USED IN THE COURSE EDUCATIONAL PROCESS

| <b>Type of Software</b>   | <b>Software branding</b>  |
|---|---|
| OS  | Windows 10 (Azure Dev Tools for Teaching)                               |
| Office Applications   | Adobe Acrobat Reader DC   |
| Image processing software   | Corel CorelDRAW Suite X4  |
| General purpose application software  | Mathematica Professional Version (licence L3263-7820*)                  |
| General purpose application software  | Microsoft Office Visio Professional 2016 (Azure Dev Tools for Teaching) |
| General purpose application software  | WinRAR (licence № 879261.1493874)                                       |
| Management systems for projects, research, development, design, modeling and implementation | Autodesk AutoCAD 2019 Education Multi-seat Stand-alone                  |

## 6.4. MODERN PROFESSIONAL DATABASES AND INQUIRY SYSTEMS USED IN THE COURSE EDUCATIONAL PROCESS

| <b>Branding</b>   | <b>Reference to information resource</b>                                  |
|---|---|
| Scopus database   | <a href="https://www.scopus.com/">https://www.scopus.com/</a>             |
| Web of Science Database   | <a href="https://www.webofscience.com/">https://www.webofscience.com/</a> |
| Scientific electronic library database (eLIBRARY.RU)                    | <a href="https://elibrary.ru/">https://elibrary.ru/</a>                   |
| Scientific Library of the Perm National Research Polytechnic University | <a href="https://lib.pstu/">https://lib.pstu/</a>                         |
| Lan Electronic Library System   | <a href="https://e.lanbookshop.ru/">https://e.lanbookshop.ru/</a>         |
| Electronic library system IPRbooks                                      | <a href="https://www.iprbookshop.ru/">https://www.iprbookshop.ru/</a>     |
| Information resources of the Network ConsultantPlus                     | <a href="https://www.consultant.ru/">https://www.consultant.ru/</a>       |
| Company database EBSCO  | <a href="https://www.ebsco.com/">https://www.ebsco.com/</a>               |

## 7. LOGISTICS OF THE COURSE EDUCATIONAL PROCESS

| <b>Type of classes</b> | <b>Name of the necessary basic equipment</b>                     | <b>Number of units</b> |
|------------------------|--|------------------------|
| Laboratory work        | PC Intel Pentium Dual CPU MHz                                    | 60                     |
| Lecture                | Type 2 multimedia complex (laptop, projector, interactive board) | 5                      |
| Practical class        | PC Intel Pentium Dual CPU MHz                                    | 15                     |

## 8. FUND OF THE COURSE EVALUATING TOOLS

Presented in a separate document



Ministry of Science and Higher Education of the Russian Federation  
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## **FUND OF ESTIMATING TOOLS**

**For students' midterm assessment in the discipline  
 Engineering geometry and computation graphics  
*Supplement to the Academic Course Working Program***

|  |                                  |
|--|----------------------------------|
| <b>Training program</b>                                      | 21.03.01 Oil and Gas Engineering |
| <b>Direction (specialization)<br/>of educational program</b> | Oil and Gas Engineering          |
| <b>Graduate qualification</b>                                | Bachelor's degree                |
| <b>Graduate academic chair</b>                               | Oil and Gas Technology           |
| <b>Form of study</b>   | Full-time studies                |

**Year: 2**

**Semester: 3**

### **Workload**

in credits 4 CU

in hours 144 h

### **The form of midterm assessment:**

Grading test: 3 semester

**Fund of estimating tools** for midterm assessment of students' learning the subject "Engineering geometry and computation graphics" is the part (supplement) to the academic course working program. Fund of estimating tools for midterm assessment of students' learning the discipline has been developed in accordance with the general part of the fund of estimating tools for midterm assessment of the basic educational program which determines the system of the midterm assessment results and criteria of putting marks. Fund of estimating tools for midterm assessment of students' learning the subject determines the forms and procedures of monitoring results and midterm assessment of the subject leaning by the students.

### 1. LIST OF CONTROLLED RESULTS OF STUDYING DISCIPLINE, OBJECTS OF ASSESSMENT AND FORMS OF CONTROL

According to the Academic Course Working Program mastering course content is planned during one semester (the third semester of curriculum) and is divided into four educational modules. Classroom activities, lectures and laboratory work as well as students' self-work are provided for every module. In the frames of mastering course content such competences as *to know, to be able, to master* pointed out in the ACWP are formed. These competences act as the controlled results of learning the discipline "Engineering geometry and computation graphics" (Table 1.1).

Monitoring of the acquired knowledge, abilities and skills is made in the frames of continuous assessment, progress check and formative assessment in the process of studying theoretical material, reports on laboratory works and during examination. Types of control is given in Table 1.1

Table 1.1 – List of controlled results of learning the discipline

| Controlled results of learning<br>the discipline (KAS)  | Type of control          |     |                   |      |                         |      |
|---|--------------------------|-----|-------------------|------|-------------------------|------|
|   | Continuous<br>assessment |     | Progress<br>check |      | Formative<br>assessment |      |
|   | D                        | AC  | LWR/<br>PWR       | T/CW |                         | Test |
| 1   | 2                        | 3   | 4                 | 5    | 6                       | 7    |
| <b>Acquired knowledge</b>   |                          |     |                   |      |                         |      |
| K.1 Knows the content of engineering documentation models connected with professional activity                          | D1                       | AC1 |                   | CW1  |                         | CT   |
| K.2 Knows the theoretical foundation of constructing drawings of objects on a plane                                     | D2                       | AC2 |                   | CW1  |                         | CT   |
| K.3 Knows the techniques for determining the forms and dimensions of objects  | D3                       | AC3 |                   | CW2  |                         | CT   |
| <b>Acquired abilities</b>   |                          |     |                   |      |                         |      |
| A.1 Is able to use the basic types and content of engineering documentation models connected with professional activity |                          |     | LWR1              |      |                         | PWR  |



| 1   | 2 | 3 | 4            | 5   | 6 | 7   |
|---|---|---|--------------|-----|---|-----|
| A.2 Is able to demonstrate the ability to generalize information and put it into the blanks of models in accordance with active standards |   |   | LWR2<br>LWR3 | CW2 |   | PWR |
| A.3 Is able to solve technical design problems using traditional tools or CAD   |   |   | LWR3<br>LWR4 | CW2 |   | PWR |
| <b>Mastered skills</b>  |   |   |              |     |   |     |
| S.1 Masters the skill of reporting, making reviews, references, requests and etc. relying on real situation                               |   |   | LWR5         |     |   | PWR |
| S.2 Masters the skill of performing projects in 3D and has intellectual capability of space perception                                    |   |   | LWR6         | CW1 |   | CT  |
| S.3 Masters the skill of handling the software for geometric modeling and visualization   |   |   | LWR7         |     |   | CT  |

*D – topic discussion; AC – colloquium (discussion of theoretical material, academic conference); CT – case-task (individual task); LWR – report on laboratory work; PWR – report on practical work; T/CW – progress check (control work); TQ – theoretical question; PT – practical task; CT – complex task of grading test.*

Final assessment of the learned discipline results is the midterm assessment which is made in the form of test taking into consideration the results of the running and progress check.

## **2. TYPES OF CONTROL, STANDARD CONTROL TASKS AND SCALES OF LEARNING RESULTS ASSESSMENT**

Continuous assessment of the academic performance is aimed at maximum effectiveness of the educational process, at monitoring students' specified competencies formation process, at increase of learning motivation and provides the assessment of mastering the discipline. In accordance with the regulations concerning the continuous assessment of the academic performance and midterm assessment of students taught by the educational programs of Higher education

– programs of the Bachelor's Course, Specialists' and Master's Course the next types of students' academic performance continuous assessment and its periodicity is stipulated in PNRPU:

– acceptance test, check of the student's original preparedness and his correspondence with the demands for the given discipline learning;

– continuous assessment of mastering the material (the level of mastering the component "to know" defined by the competence) at every group studies and monitoring of lectures attendance;

– interim and progress check of students' mastering the components "to know" and "to be able" of the defined competences by computer-based or written testing, control discussions, control works (individual home tasks), reports on laboratory works, reviews, essays, etc.

Discipline progress check is conducted on the next week after learning the discipline module, while the interim control is made at every monitoring during the discipline module study;

- interim assessment, summarizing of the current students' performance at least once a semester in all disciplines for every training program (specialty), course, group;
- retained knowledge control.

## 2.1. CONTINUOUS ASSESSMENT OF EDUCATION

Continuous assessment of learning is made in the form of discussion or selective recitation on every topic. According to the four-point system the results of assessment are put into the teacher's note-book and are considered in the form of integral mark in the process of the midterm assessment.

## 2.2. PROGRESS CHECK

For the complex assessment of the acquired knowledge, abilities and skills (Table 1.1) it is made the progress check in the form of laboratory work presentation and midterm control works (after learning every discipline module).

### *2.2.1. Presentation of laboratory work*

It is planned 7 laboratory works all in all. Standard topics of laboratory work are given in ACWP.

Presentation of laboratory work is made by the student individually or by the group of students. Standard scale and criteria of assessment are given in the general part of FET of the educational program.

### *2.2.2. Midterm control work*

According to ACWP 2 midterm control works (CW) is planned to be realized after learning the educational modules of the discipline by the students.

The first CW is realized with respect to the module 1 "Projections", the second CW – with respect to the module 2 "Design Solid Models".

## 2.3. FULFILLMENT OF THE COMPLEX INDIVIDUAL SELF-WORK TASK

Individual complex tasks for the students are used for assessment of their skills and abilities acquired in the process of learning the discipline in which the course project or course paper is not stipulated.

Standard scale and criteria of assessment of the individual complex task presentation are given in the general part of FET of the educational program.



## 2.4. MIDTERM ASSESSMENT (FINAL CONTROL)

Admission for midterm assessment is made according to the results of continuous assessment and progress check. Preconditions for admittance are successful presentation of all laboratory works and positive integral estimation with respect to the results of continuous assessment and progress check.

### *2.4.1. Midterm assessment procedure without additional evaluation testing*

Midterm assessment is made in the form of a test. Credit on the discipline is based on the results of the previously fulfilled by the student individual tasks on the given discipline.

Criteria of putting the final mark for the components of competences in the process of midterm assessment made in the form of test are given in the general part of FET of the educational program.

### *2.4.2. Midterm assessment procedure followed by evaluation testing*

In definite cases (for example, in case of re-attestation of the discipline) midterm assessment in the form of the test on this discipline can be made as the ticket-based evaluation test. Every ticket includes theoretical questions(TQ) aimed at control of the acquired knowledge, practical tasks (PT) aimed at mastered abilities, and complex tasks (CT) aimed at control of the acquired skills of all declared competences.

The ticket is formed so that the included questions and practical tasks could estimate the level of maturity of **all** declared competences.

#### **2.4.2.1. Standard questions and tasks the discipline testing**

##### **Standard questions for the acquired knowledge control:**

1. The multiview drawing of a point and a straight line.
2. Relative position of lines and planes.
3. Conic sections.
4. Principal views.
5. What are the different types of sectioning?
6. What is an assembly drawing?
7. What is the difference between a detail drawing and an assembly drawing?
8. What is the difference between parametric and nonparametric models?

##### **Standard questions and practical tasks for the mastered abilities control:**

1. The true length of a line and its angles of inclination.
2. Solving problems involving the surface and the plane

3. Determine the minimum number of views needed to completely describe the object.

4. Creating the three-view drawing of an object.

5. Creating the two-view assembly drawing.

**Standard complex tasks for the acquired skills control:**

1. Recognizing the multiview drawings of solid primitive shapes in 3D modeling.

2. Predefining multiviews and changing the view point on a 3 CAD model.

3. Creating the 3D model of an object.

4. Representation of various types of machine holes, fillets and chamfers.

5. A technology bottom-up design in assembly modeling.

6. Creating assembly models in 3D CAD.

**2.4.2.2. Scales of test assessment of educational achievements**

Evaluation of discipline achievements in the form of maturity level of the components *to know, to be able, to master* of the declared competences is made according to the four-point assessment scale.

Standard scale and criteria of estimating educational achievements in the process of testing for the components *to know, to be able, to master* are given in the general part of FET of educational program.

**3. ASSESSMENT CRITERIA FOR COMPONENTS  
AND COMPETENCES LEVEL OF MATURITY**

**3.1. ASSESSMENT OF COMPETENCES COMPONENTS LEVEL  
OF MATURITY**

While estimating the level of competences maturity by selective control in the process of testing it is considered that *the mark obtained for the components of the examined competence is combined with the corresponding component of all competences formed in the frames of the given academic course.*

General assessment of maturity level of all competences is made by aggregation of marks obtained by the student for each component of the formed competences taking into account the results of continuous assessment and progress check in the form of integral mark according to the four-point scale. All control results are put into the assessment sheet by the teacher according to the results of midterm attestation.

The form of the assessment sheet and requirements for its completion are given in the general part of FET of the educational program.

While making the final assessment of the midterm attestation in the form of test standard criteria given in the general part of FET of the educational program are used.