COURSE SYLLABUS
ENGINEERING GRAPHICS CAD 1.1
ENGINEERING GRAPHICS CAD 2.1

STUDY MAJOR:

15.03.01 Mechanical Engineering
09.03.01 Computer Science

QUALIFICATION (DEGREE)   **Bachelor**
Admission of 2014 year
YEAR _____1_____Semester _____1, 2___
CREDITS 3/3
DISCIPLINE CODE (ДИСЦ.Б.М1/ ДИСЦ.Б.М2)

FORM OF STUDY	STUDY TIME ALLOCATION:	
	15.03.01 Mechanical Engineering	09.03.01 Computer Science
LECTURES, h	16	16
PRACTICAL CLASSES, h	56	32
LABORATORY WORKS, h	24	-
CLASS HOURS, h	96	48
SELF-STUDY, h	120	60
TOTAL, h	216	108

FINAL ASSESSMENT   Final Test, Examination
DEPARTMENT   Interdisciplinary

HEAD OF DEPARTMENT   G.V. Kashkan_____

HEAD OF GENERAL EDUCATIONAL

PROGRAM   V.N.Kozlov_____

O. V. Marukhina _____

LECTURER   R.G. Dolotova_____

2014

1. Course objectives

The main objective is to introduce students to aspects of engineering graphics and to develop professional and universal competencies necessary for graphic solutions of engineering and drafting problems.

The course aims to enable students to:
1. Gain a better understanding of key rules of the image of various spatial geometric figures on a plane, rules of graphic registration while studying special disciplines through participation in lectures and seminars.
2. Broaden their exposure to the practical application of gained knowledge, skills and tools; gain experience in problem-solving through active participation in seminars and self-study and working within a group of individuals having diverse viewpoints and academic backgrounds.
3. Engage and develop advanced skills which are practical and transferable to a wide range of employment contexts and life experiences.
4. Adjust to the academic culture of a university setting.
5. For students wishing to do so, develop and enhance IT skills through self-directed and self-paced study.

2. Course within the General education program

"Descriptive Engineering the graphics CAD" is one of the basic disciplines of a professional cycle, providing studying issues of graphic and geometrical modeling of concrete engineering products. It provides students with a minimum of fundamental engineering - geometrical knowledge, skills in the field of geometrical modeling on the basis of which the future expert can successfully study applied mechanics; theoretical mechanics; designing of the specialized electronic devices, designing of systems of automated management by technological lines and processes to carry out a graphic part of course and degree projects.

3. Course Learning Outcomes

The main planned outcome (result) is:

Table 1

№	Result
R1	An ability to apply skills of spatial objects image on flat drawings
R2	An ability to apply skills in designing typical details and their connections; registration of the part lists and technical documentation
R3	An ability to carry out sketches, work drawings of details and assembly units, to use computer schedules means

Results of successful completion of the course «Descriptive Engineering graphics CAD» are introduced in Table 2

Table 2

competencies	Results					
	code	knowledge	code	skills	code	competencies
UC – 1 Possession of culture of thinking, ability to generalization, the analysis, perception of the information, statement of the purpose and choice of ways of its achievement, skill is logically true, is argued and clearly to build oral and written speech **UC-10** Readiness to use organic laws of natural-science disciplines in professional work to apply methods of the mathematical analysis and modeling, theoretical and an experimental research	K1.1 K1.2	Theoretical bases and laws of construction and reading of separate views and drawings of geometrical objects; Methods Constructions on a plane of spatial forms and objects	S1.1 S1.2	To use the received knowledge at development of a teaching material of the subsequent disciplines, and also in the subsequent engineering activity; To use the received knowledge in the subsequent engineering activity	C1.1 C1.2	In the ways and receptions of the image of subjects on a plane; Methods Constructions of development of various surfaces with drawing of elements of a design on development and convolution
UC-5 Ability to use standard legal documents in the activity **PC-11** Ability to develop design and engineering part lists to make out the finished construction work;	K2.1 K2.2	The theory of construction of technical drawings; Rules of registration of the design documentation	S2.1 S2.2	To carry out and read technical schemes, drawings and sketches of details, knots and units, assembly drawings and general views of average degree of complexity; To use the studied standards of ESKD	C2.1 C2.2	Independent removal of sketches and performance of drawings of various technical details and elements of a design of knots of products; Skills of views of technical products, registrations of drawings, electric schemes and drawing up of part lists
PC -7 Ability to own elements of descriptive geometry and the engineering drawing to apply modern software of performance and editing of views and drawings and	K.3.1	Development of knowledge, on application of software for creation,	S3.1	To carry out drawings of technical products and schemes of technological processes with	C.3.1	In the ways and receptions of the image of subjects on a plane, one of the graphic

preparation of the technological documentation **PC - 12** Readiness to carry out control of conformity of developed projects and engineering part lists to standards, part lists and other standard documents;		editing and registration of drawings		use of means of computer graphics		

After successful completion of the course, students will have:

1) knowledge of

- role of a rate in practical activities of the expert;
- terminology, the basic concepts and definitions;
- construction methods on a plane of spatial objects;
- ways of the decision on drawings of the basic metric and item tasks;
- basic requirements to drawings registration according to standards of «Uniform system of the design documentation » (ESKD).
- use the received knowledge in the subsequent disciplines;
- solve tasks on a mutual accessory and mutual crossing of geometrical figures, on definition of full size of flat geometrical figures;
- define geometrical form details of an average degree of complexity under their views;
- use the investigated standards of ESKD;
- carry out an average degree of complexity details drawings

2) skills in

- dealing with reference books;
- working autonomously;
- searching for the scientific information in library fund and through the Internet;
- solving tasks on a mutual accessory and mutual crossing of geometrical figures, on definition of full size of flat geometrical figures;
- defining geometrical form details of an average degree of complexity under their views;
- using the investigated standards of ESKD;
- carrying out an average degree of complexity details drawings

3) competencies:

- Ability to carry out redesign inspection of object, system analysis of a subject domain, their interrelations (PC-1);

- Ability to carry out technical designing (PC-2);
- Ability to carry out design engineering (PC-3);
- Ability to carry out a choice initial given for designing (PC-4);
- Ability to carry out modeling of processes and systems (PC-5);
- Ability to estimate reliability and quality of functioning of object of designing (PC-6);
- Ability to carry out certification of the project on the quality standards (PC-7);
- Ability to carry out calculation of maintenance of conditions safe abilities to live (PC-8);
- Readiness to develop, coordinate and release all kinds of the design documentation (PC-10).
- Ability to carry out gathering, the analysis of the scientific and technical information, domestic and foreign experience on subjects researches (PC-23);
- Ability to make out the received working results as presentations, scientific and technical reports, articles and reports at scientific and technical conferences (PC-27);
- Ability to form new competitive ideas and to realize them in projects (PC-28).

4. Course structure and content

The Lecture material is composed of the following sections:

1. Introduction and general provisions.

Introduction. Projection method. Central and parallel projections. Convertibility of the drawing. Planes of projections. The complex drawing.

2. Point, a straight line, a plane.

Drawing of a point. Displaying of a point on two and three planes of projections. Mutual position of two points. Straight line. Straight lines of the general position. Straight lines of particular position. Mutual position of a point and two a line. Mutual position of two straight lines. Representation of a plain in a drawing. The point and the line in the plane. Mutual position of a line and a plane. Mutual position of the planes.

3. Surfaces.

Determining and specifying surfaces in a drawing. Classification. Point and a line on the surface. Polyhedrons surfaces, surfaces of rotation. Screw surfaces. Mutual intersection of surfaces.

4. Axonometric projections

The method of axonometric projection. Foreshortening factor. Isometric. Dimetric. Representation of a circle and a sphere in axonometric. Oblique axonometric.

5. The principal rules of a drawing representation

Unified system of engineering papers. Formats and title blocks. Scales. Lines. Lettering. Representations. Basic rules and definitions. The views. Sectional views. Sections. Conventions and simplifications. Removed view. Dimensioning. Joints.

6. Sketches of Details. Assembly Drawing

Introduction. Choice of the Principle View. The Sequence of the Sketch Fulfillment. Measuring Tools and Measurement Technical Procedures. Purpose and Content of Assembly Drawings. Part list Composition. Numbering the Positions. Assembly Drawings Extra Data. Sealing Devices. Conventions and Simplifications.

7. Overall Drawing Detailing

Overall Drawing Concept. Sequential Steps of Detailing.

8. Fundamentals of Computer – aided Design (CAD)

Introduction to CAD.
Introduction to AutoCAD.
Introduction to INVENTOR.

5. Course activities

The combination of educational technologies, given in Table 3, provides achievement of the expected outcomes (results).

Teaching methods and learning forms

Table 3

Methods	Learning forms			
	Lectures	Laboratory works	Practical classes	Self-Study
IT- Methods	+	+	+	+
Teamwork		+	+	+
Experience-based learning		+	+	
Advanced self-study				+
Search	+		+	
Investigation		+	+	+

6. Self-study program

6.1. Types and forms of self-study

Term-time self-study aimes at deepening student's knowledge, developing practical skills. It includes studying theoretical and lecture material, research, completing individual graphic works, preparing for practical classes and laboratory works, tests and examination.

Creative problem-oriented autonomous work is aimed at developing intellectual skills, common cultural and professional competencies through participation in scientific student's conferences and Olympiads, completion of individual graphic tasks. More than 30 variants of graphic tasks are designed by the faculty (See Appendix 1-7).

List of graphic works

1. Standards of registration of drawings (title page) (format A3).
2. Transformation of the drawing of a straight line and a plane (format A3).
3. Bodies with aperture. Polyhedrons with an aperture (format A3).
4. Representations. Dimensioning. Axonometric Projection (format A3).
5. Joints (format A4; format A4).
6. Sketches of Details (format A3, A4)
7. Assembly Drawing (format A3)
8. Overall Drawing Detailing (format A3, A4)

6.2 Self-study content

Themes for self-directed learning:

Part 1

1. Ways of drawing transformation
2. Ways of surfaces development construction
3. Definition of lines of intersection between surfaces
4. Connections
5. Surface roughness
6. Solid modeling
7. Studying CAD tools for creation of documents and editing of views

Part 2

1. Key rules of performance of drawings. A point.
2. The Straight line. Mutual position of straight lines. Transformation of the drawing of a straight line. A plane. A point and a straight line in a plane.
3. Surfaces. Bodies with cut. Surface development.
4. Construction of an axonometric of a detail.
5. Graphic representations.
6. Representations. Sectional views.

7. Sketches of Details. Assembly Drawing.
8. Overall Drawing Detailing

6.3. Self-study control

The assessment of self-study results is organized as synthesis of two forms: self-check and teacher's control (at lectures, practical classes, examinations)

Questions for Self-study

1. In what case the point projection will coincide with a point - the original?
2. In what case at the central projections the straight line projection represents a point?
3. In what the way of projections named the parallel consists?
4. If the point belongs to a straight line as their projections settle down?
5. For what purpose addition of projective drawings is used?
6. Name ways of addition of projective drawings?
7. What line is called as the communication line?
8. At what position concerning planes of projections the straight line is called as general provisions straight line?
9. How the straight line in system of planes H, V, W if all three projections of a piece of this straight line are equal among themselves is located?
10. How to construct a profile projection of a piece of a straight line of general provisions according to face-to-face and horizontal projections?

6.4. Methodical support of students self-studying

1. Vinokurova G.F., Stepanov B.L. Engineering graphics. Textbook. – Tomsk: TPU Press, 2000, 170 pp.
2. Vinokurova G.F., Stepanov B.L, Gorisev S.A. Engineering graphics and CAD. Textbook. – Tomsk: TPU Press, 2000, 137 pp.
3. Burkova S.P.,Vinokurova G.F., Dolotova R.G., Stepanov B.L. Descriptive geometry. Textbook. – Tomsk: TPU Press, 2011, 165 pp.
4. Hart K.R. Engineering graphics. With problems and solutions. Textbook. – London, 1975, 188 pp.
5. Morling K. Geometric and Engineering drawing. Textbook. – London, 1974, 263 pp.
6. http://www.archive.org/stream/descriptivegeome
7. http://quod.lib.umich.edu/u/umhistmath
8. http://ru.scribd.com/doc/39479843/Schaum-Descriptive-Geometry
9. http://portal.tpu.ru/departments/kafedra/ngg/metodizki

7. Term-time and final assessments

Entry Test. Includes test tasks related to secondary school program on "Mathematics" and "Technology", carried out in written form.

Current assessment. During a semester, tests are carried out after completion of each course section. Aim is to measure the level of the theoretical and practical knowledge, and attained skills. (see Appendix 2-4).

Individual tasks (graphic works*)*. Goal: to measure an ability of making independent decision on specific targets

1. Standards of registration of drawings (title page) (format A3).
2. Transformation of the drawing of a straight line and a plane (format A3).
3. Bodies with aperture. Polyhedrons with an aperture (format A3).
4. Representations. Dimensioning. Axonometric Projection (format A3).
5. Joints (format A4; format A4).
6. Sketches of Details (format A3, A4)
7. Assembly Drawing (format A3)
8. Overall Drawing Detailing (format A3, A4)

Final control in 2 forms: 1st semester – final test, 2nd semester- graded test

Examination (in written and oral form) at the end of a semester includes theoretical questions and practical tasks on all course sections.

Rated learning activities are presented in the Table 6

Table 6

Rated learning activity	Result
Practical tasks completion	R-1; R-2; R-3
Laboratory works performance	R-1; R-2; R-3
Reports on individual tasks	R-1; R-2; R-3
Presentations of research at "conference week"	R-1; R-2; R-3
Active participation in scientific discussion	R-1; R-2; R-3
Test completion	R-1; R-2; R-3
Final Test	R-1; R-2; R-3
Graded Test	R-1; R-2; R-3

Control questions for laboratory works

1. What are two ways of representation of views?
2. What spectrum of possibilities does system AutoCAD possess?
3. In what order is it necessary to carry out drawings in system AutoCAD?
4. What is definition of a sheet format, in what way measure of units demanded accuracy is carried out?
5. How are desktop additional panels of tools and the separate buttons necessary for work deduced?
6. What are commands of management?
7. How to record a file on a disk and in what way leaving AutoCAD system is carried out?

8. What is the objective binding? List the objective bindings used in AutoCAD.
9. What kinds of co-ordinates systems are used AutoCAD?
10. Describe methods of co-ordinates points input.

Control questions for practical classes

1. What is the essence of projections process?
2. How the point projection the central projections is under construction?
3. How the parallel projection of a straight line is under construction?
4. Whether 4. The parallel projection of a straight line Can represent a point?
5. What properties, are the general for the central and parallel projections?
6. What is called after a straight line on a plane of projections?
7. What co-ordinate is equal to zero: for a face-to-face trace of a straight line; for a horizontal trace of a straight line?
8. Where the horizontal projection of a face-to-face trace of a straight line settles down?
9. Where the face-to-face projection of a horizontal trace of a straight line settles down?
10. How V two crossed lines are represented in system of planes H?

Control questions for individual graphic works;

1. Definition of full size of a piece of a straight line of general provisions and angles of slope to planes of projections.
2. The Theorem of right angle projections.
3. Kinds and ways of formation of surfaces of rotation.
4. Properties of projections of crossed straight lines. Competing points. On an example of definition of visibility of edges of a polyhedron show, how visibility of points and straight lines on the drawing is defined?
5. Foreshortening factor in an axonometric. The formula showing an interconnection of factors among themselves. The basic theorem of an axonometric.
6. The Basic kinds-names, the image, a designation.
7. The Portable element-name, the image, a designation.
8. Drawing Rules on the drawing of the sizes of arches and circles.
9. The Additional kind-name, the image, a designation.
10. Types of cuts depending on quantity of secants of planes.

Test Sample

1. On what drawing of a plane are crossed on direct, parallel plane H.

1. 2. 3. 4. 5.
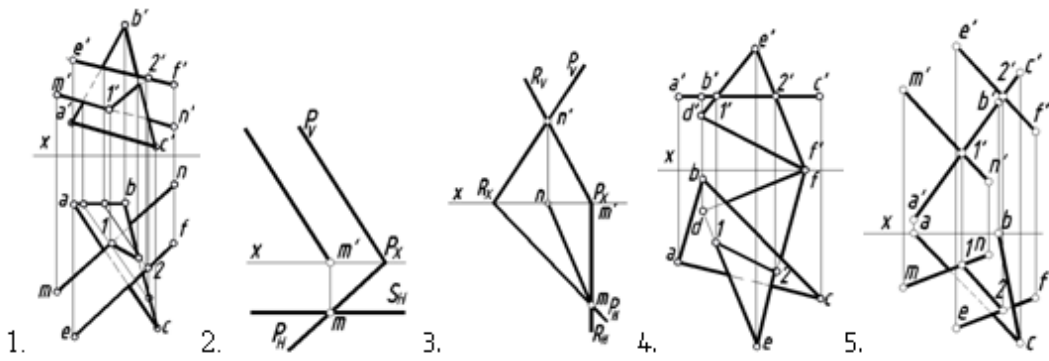
2. On what drawing of a plane are crossed on direct, parallel plane V.

1. 2. 3. 4. 5.
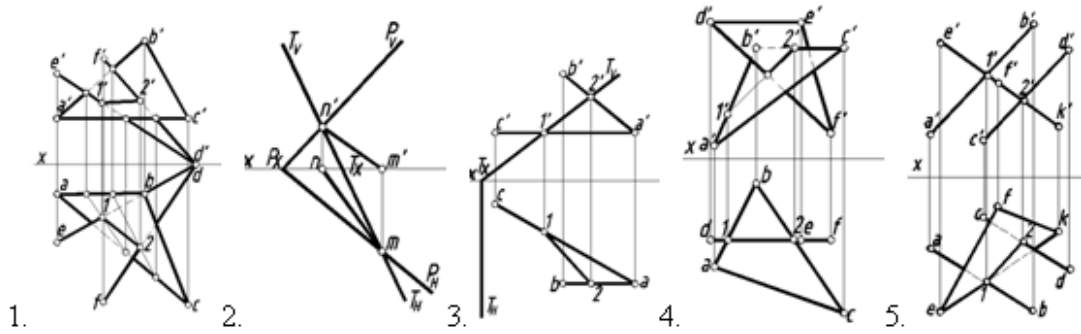
3. On what drawing of a plane are crossed on a direct, perpendicular plane V.

1. 2. 3. 4. 5.
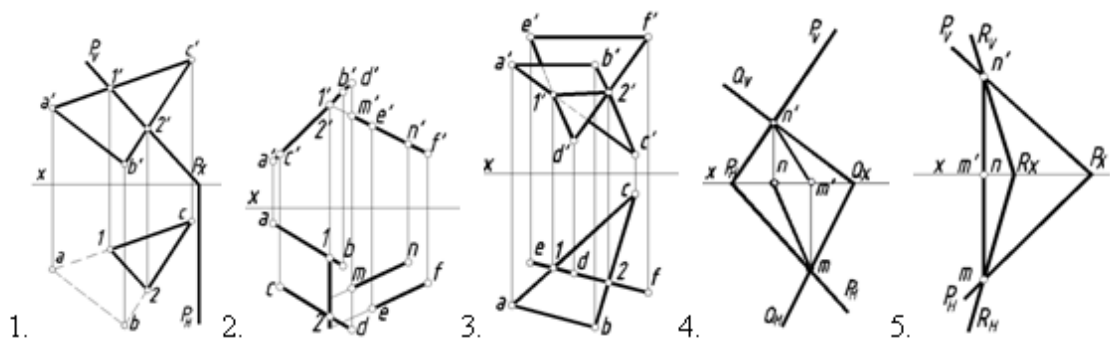
4. On what drawing of a plane are crossed on a direct, perpendicular plane H.

1. 2. 3. 4. 5.
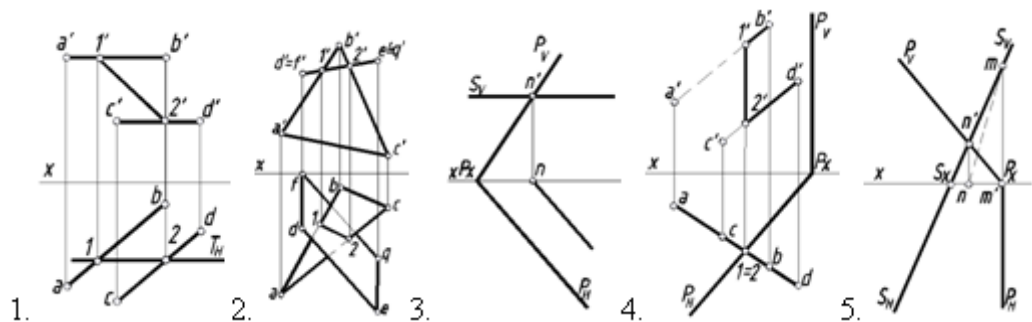
5. On what drawing the point of intersection of a straight line with a plane belongs to plane H

1.   2.   3.   4.   5.
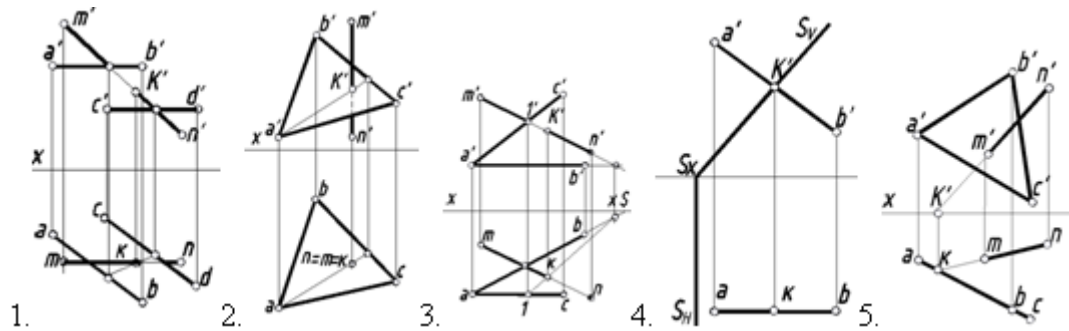
Questions for final and graded tests

1. What is the method of construction of the central projection of a point?
2. In what case is the central projection of a straight line represented by a point?
3. What location relative to the projection planes causes a line to be called "a line of general position"?
4. What is the locus of a line in the system of the planes *H, V, W* given all three projections of the line are equal in length?
5. How do we construct a profile projection of a line of general position given its frontal and horizontal projections?
6. What positions of a straight line in the system of *H, V, W* planes are considered to be the particular ones?
7. What is the position of a frontal projection of a line-segment given its horizontal projection is equal to the line-segment proper?
8. Under what conditions does a point belong to a plane? What lines are referred to as the principal lines of the plane?
9. What are the terms of a line and a plane to be parallel?
10. How can you find the meeting point of a line and a plane?
11. What are the relative positions of the planes?
12. What determines mutual parallelism of two oblique planes in a drawing?
13. What is the way of drawing an intersection line of two planes?
14. What is the gist of the replacing planes of projection method?
15. What mutual relations must the old and new planes of projections have?
16. What lines on a surface of rotation are referred to as parallels and meridians?
17. How is a surface of helicoid formed?
18. What is the essence of the method of axonometric projection?
19. Formulate the principal theorem of axonometry.
20. What is the coefficient of distortion?
21. How are the coefficients of distortion related to each other?
22. How are the axonometric projections classified according to the direction of projecting and the comparable value of the coefficients of distortion?
23. What is the way of determining the direction of the major and minor axes of an ellipse, if ellipse is the isometric and dimetric projection of a circle?
24. What line is called the outline of the axonometric projection of a sphere?
25. What representation is called an auxiliary view, a detail view? In what cases are they

26. What sectional view is referred to as a scrap one?
27. In what cases are the sectional views not designated?
28. What letters denote the sectional views?

8. References

Basic (B)
1. Vinokurova G.F., Stepanov B.L. Engineering graphics. Textbook. – Tomsk: TPU Press, 2000, 170 pp.
2. Vinokurova G.F., Stepanov B.L, Gorisev S.A. Engineering graphics and CAD. Textbook. – Tomsk: TPU Press, 2000, 137 pp.
3. Burkova S.P.,Vino kurova G.F., Dolotova R.G., Stepanov B.L. Descriptive geometry. Textbook. – Tomsk: TPU Press, 2011, 165 pp.

Additional (A)
1. Hart K.R. Engineering graphics. With problems and solutions. Textbook. – London, 1975, 188 pp.
2. Morling K. Geometric and Engineering drawing. Textbook. – London, 1974, 263 pp.

Software and Web sources

1. Slides Power Point at lecturing and carrying out of practical employment.
2. Graphic package AutoCAD at carrying out of laboratory researches.
3. Graphic package Inventor at carrying out of laboratory researches
4. Electronic posters on sections of a rate.
5. http://www.archive.org/stream/descriptivegeome
6. http://quod.lib.umich.edu/u/umhistmath
7. http://ru.scribd.com/doc/39479843/Schaum-Descriptive-Geometry
8. http://portal.tpu.ru/departments/kafedra/ngg/metodizki

9. Facilities

№	The name (educational audiences, computer classes, the equipment)	Building - Room
1	Educational audience, projector	10- 412
2	Educational audience, projector, interactive board, breadboard models	10 - 416,
3	Computer class, computers	10 - 302 a

The syllabus is drawn on the basis of State Educational Standard for international students following the major:

15.03.01 Mechanical Engineering, 09.03.01 Computer Science
The program is approved at the meeting of the Interdisciplinary Department (the protocol No. 1 "03" 09. 2014).

Author:

Associate Professor, Interdisciplinary Department _____ R.G. Dolotova
Reviewed by: _____Prof. N.A. Antipina

Sample of the task of the entrance control

Variant №1
Specify the correct representational of section A-A
Variants of answers

1.

A – A

3.

À – À

2.

A – A

4.

A – A
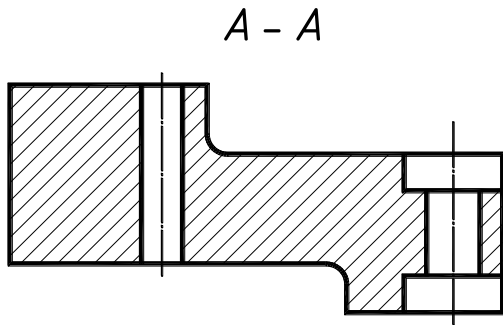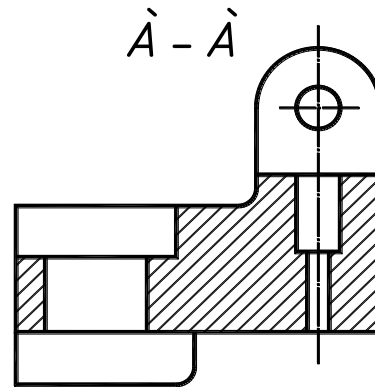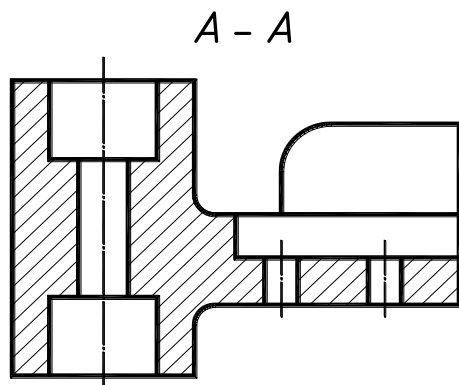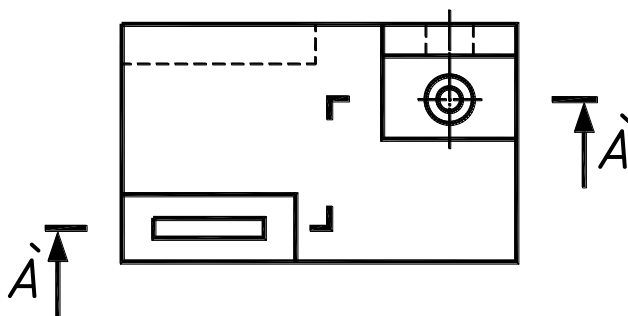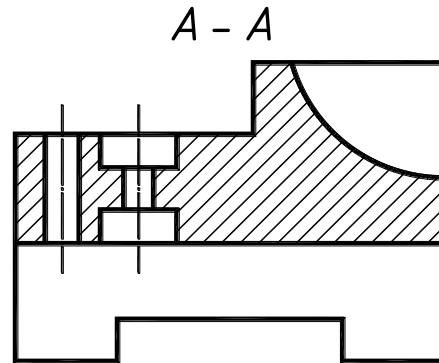
Sample of examination card
Variant №1
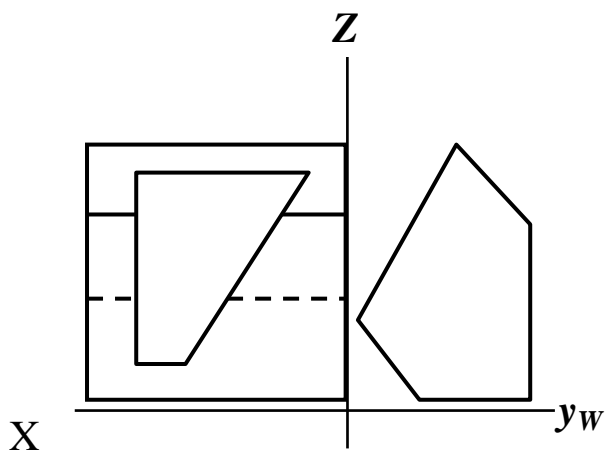1. Construct three projections of a pyramid with an aperture.
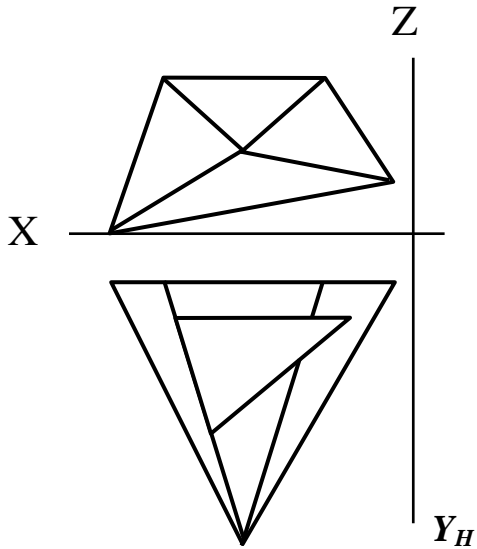
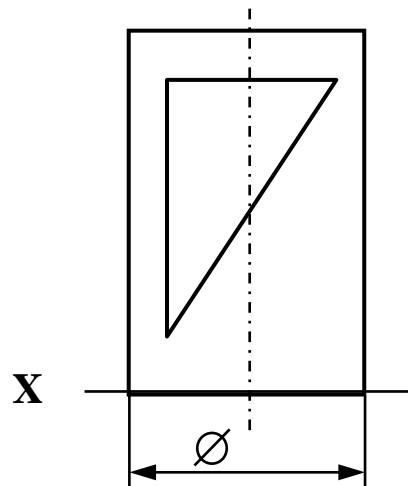2. Construct three projections of a cone with an aperture.
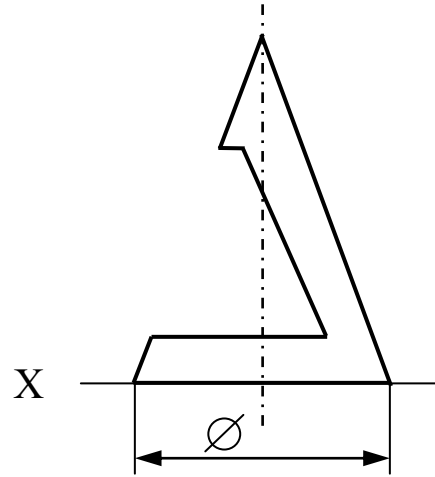
Variant №2
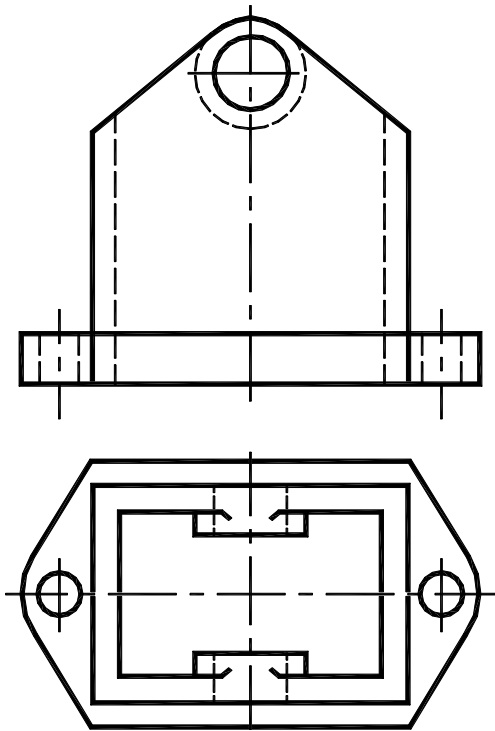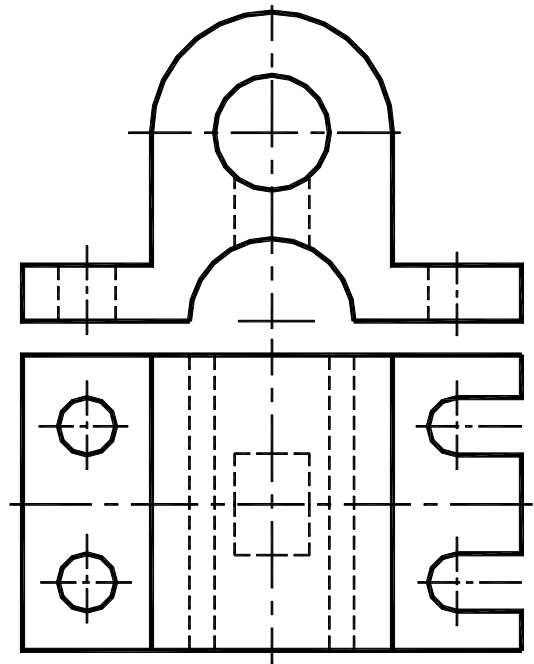1. Construct three projections of a prism with an aperture.

2. Construct three projections of a cylinder with an aperture.

Sample of examination card № 2

Below two given views, construct three views of a detail. Execute necessary sections. Put the sizes.

Variant №1

Variant №2

Sample of examination card № 3

Variant №1
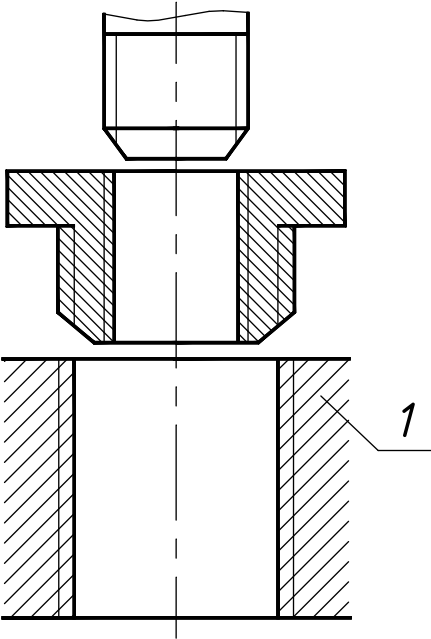
1. Draw details in assembly, on a detail *1* designate a pipe thread 1¼″.
2. Two details (the plate and the cylinder) are connected by the soldering. Draw two views of a product. Put the sizes. Designate a seam of connection.

Sample of examination card № 4

On a general view, execute the drawing of the specified detail.

Graphic work №1 "Title page"

Write words GRAPHIC WORKS font 10, capital letters. Arrange an inscription in the center of a sheet, in the sizes specified on a sample

Graphic work № 2, 3 «Bodies with an aperture»

Task: Construct three projections of a polyhedron and a surface of rotation with an aperture.

Variant 1
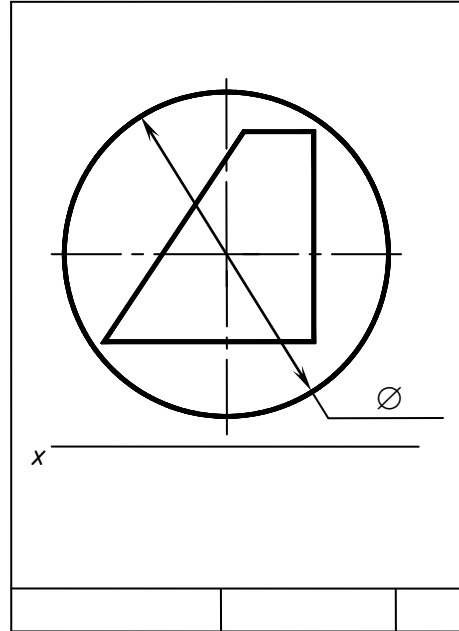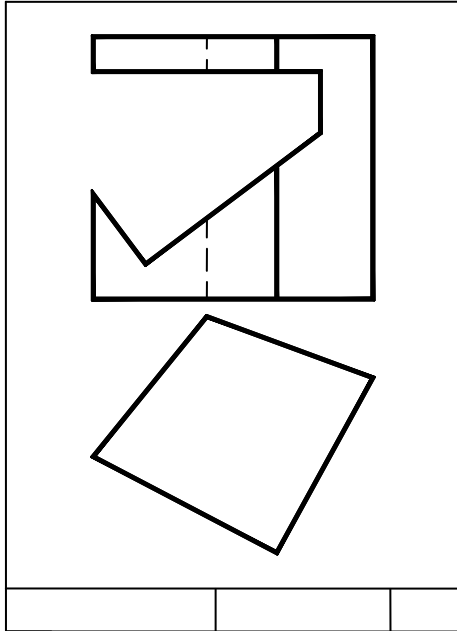
Variant 2
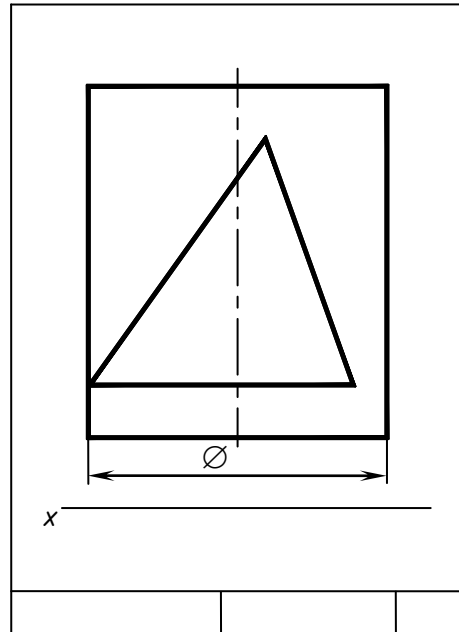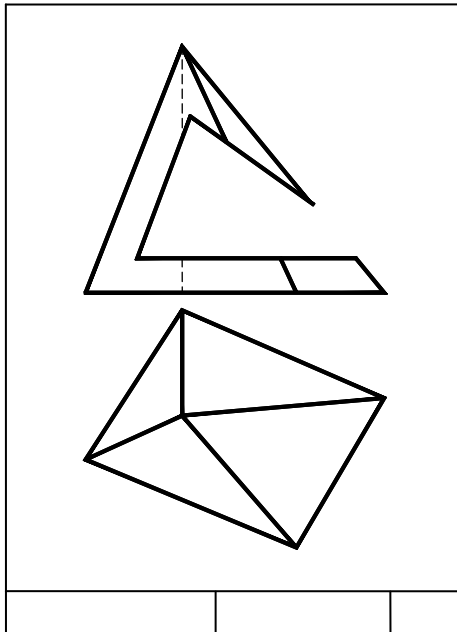
Graphic work № 4

1. On two given, construct three views of a detail, execute rational sections, put the sizes. Construct a isometric of a detail.
2. On two given, construct three views of a detail, execute rational sections, put the sizes. Construct sections of a detail the set inclined plane.

| **Variant 1**			
The basis	**Steel 45**	**The case**	**Steel 45**
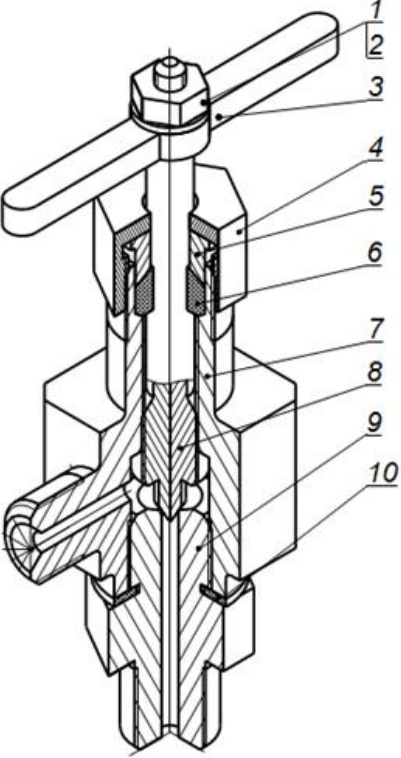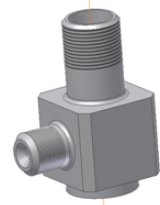
Graphic work № 5

Construct the drawing of connection by a bolt.

Bolt M22x70
Nut 2M22
Washer 22
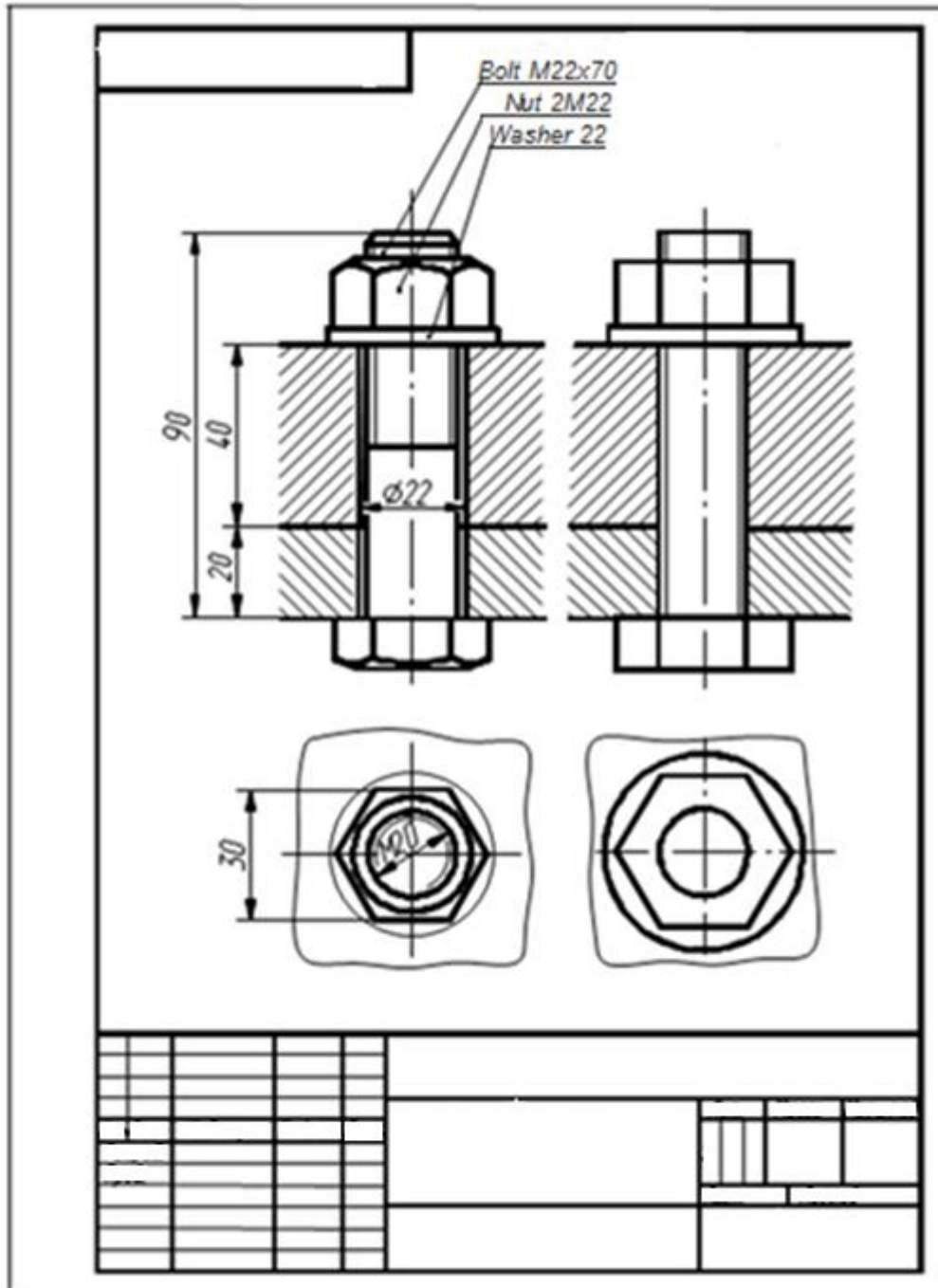
Graphic work № 6

Construct sketches of details, an assembly drawing, make the part list.

Angle valve

1 – Nut M8; 2 – Washers 8; 3 – Handle; 4 – Captive nut; 5 – Press bushing; 6 – Insert; 7 – Housing; 8 – Spindle; 9 – Union; 10 – Insert.

Handle	Steel (St.3)
Captive nut	Steel (St.5)
Press bushing	Steel (St.3)
Housing	Steel (St.3)
Spindle	Steel (St.3)
Union	Steel (St.3)
Nut M8	
Washers 8	

Graphic work № 7

On a general view, execute the drawing of the specified details.
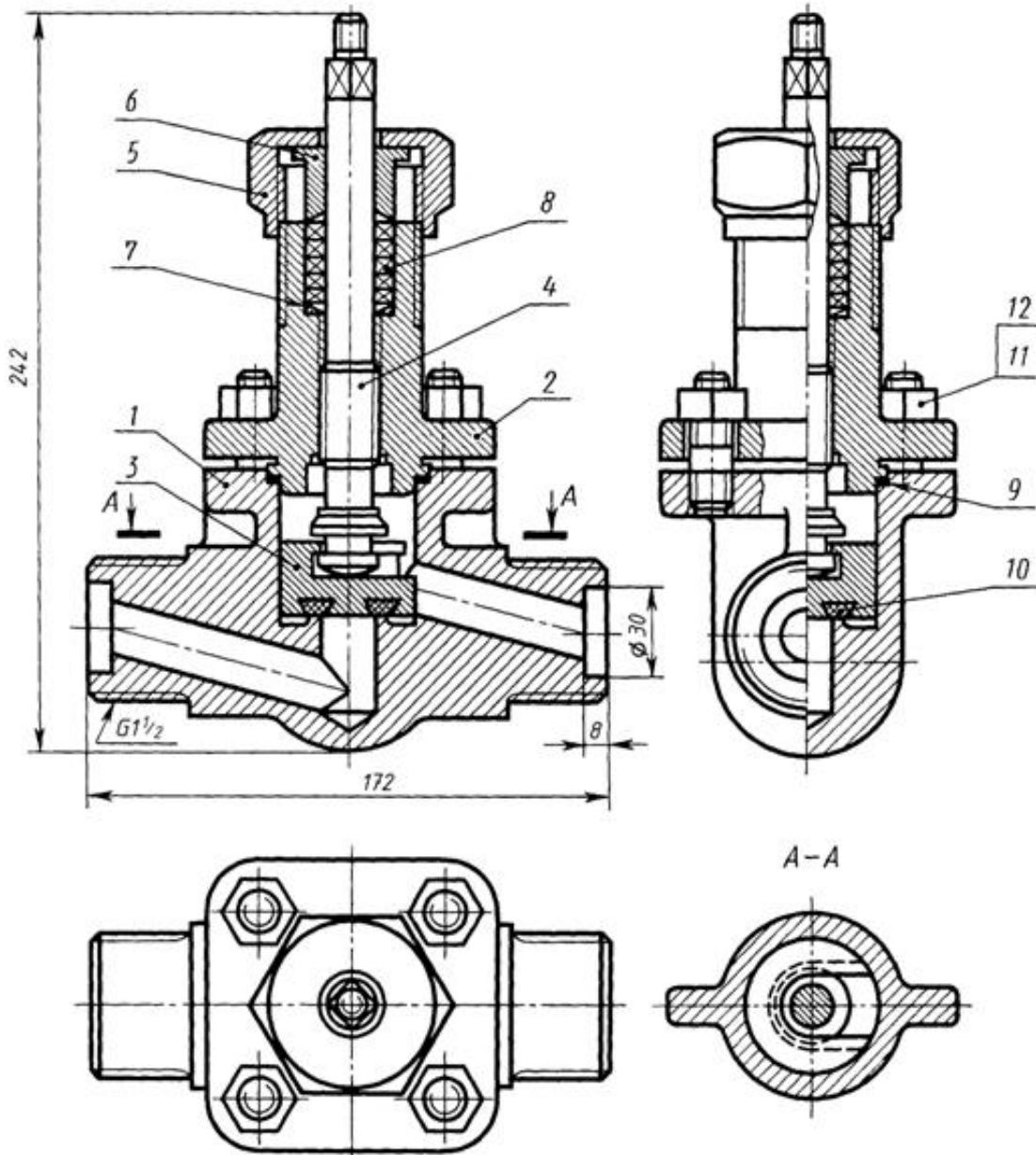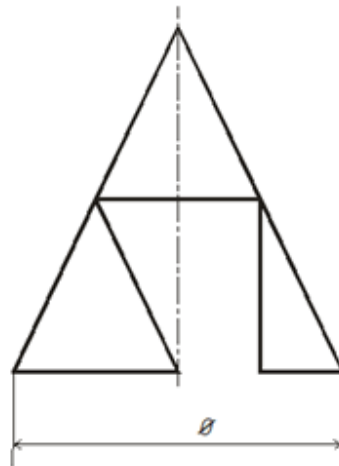
Final Test Sample

THE EXAMINATION CARD № 5

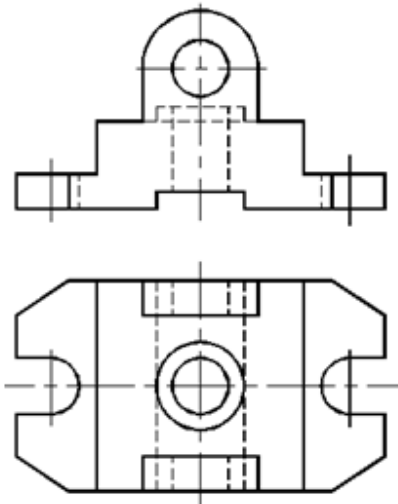**DISCIPLINE:** *Descriptive geometry and engineering graphics*
STUDY MAJOR: 150700 Mechanical Engineering;
230100 Computer Science; 140400 Electrical Engineering

Semester 1

1. Construct three views of a pyramid with a prism notch   (15 points)

2. Construct three views of the component shown, given two data. Draw rational sections. Show the dimensions. Construct isometric of the component with a partial notch. (25 points)

HAS MADE
Lecturer   _____ /R.G. Dolotova/
I ASSERT
Heard of department   _____ /G.V. Kashkan/
«____»_____2013 г.

Graded Test Sample

THE EXAMINATION CARD № 5
DISCIPLINE: *Descriptive geometry and engineering graphics*
STUDY MAJOR: 150700 Mechanical Engineering;
230100 Computer Science;140400 Electrical Engineering

Semester 2

1. What simplifications are used when the projections of the intersection lines of surfaces are drawn? Are the small angles of taper and slopes shown in all drawings? How is knurling drawn? (5 points)
2. What is "right-hand" ("left-hand") thread? How are these terms shown in thread designation? What is the difference between designations of threads with coarse and fine pitch? (5 points)
3. Construct a working drawing of a detail the 1. (30 points)