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Almaty University of Power Engineering and Telecommunications

Department of Radio Engineering and Information Security

INFORMATION AND COMMUNICATION TECHNOLOGIES

Methodological instructions for carrying out computation graphic papers in specialty
5B100200 – Information security systems

Almaty 2017

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Special assignments and practical exercises necessary in mastering the course «Information and communication technologies» are presented in the recommendations. Basic approaches and methods to solve problems that arise while using information and communication technologies are explained.

Pictures – 23, tables – 12, ref. – 8 items.

Reviewer: S.B.Bukhina

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Introduction

The discipline «Information and communication technologies» includes all aspects of creating, monitoring and research of telecommunication networks and systems.

For mastering the course and studying basic concepts in the field of information and communication technologies, it is necessary to perform three computation graphic papers on the topics: «Organization of document appearance by means of MS Office World», «Creation of multimedia presentations by means of MS Power Point», «IP addressing».

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1 Computation graphic paper № 1. Organization of document appearance by means of MS Office World

1.1 Assignment

1. According to your variant, choose a report subject (table 1.1).
2. Write the title page of the computation graphic paper in compliance with the standard of making out AUPET graphic papers in MS Office Word environment.
3. Organize the appearance of the report in MS Office Word environment, considering requirements for the standard of making out AUPET documents.

T a b l e 1.1 – Report topics

Variant	Topics
1	ICT role in key sectors of society development. Standards in the field of ICT.
2	Introduction to computer systems. Architecture of computer systems.
3	Software. Operating systems.
4	Human and computer interaction.
5	Database systems.
6	Data analysis. Data management.
7	Networks and telecommunications.
8	Cyber security.
9	Internet technologies.
10	Cloud and mobile technologies.
11	Multimedia technologies.
12	Smart-technologies.
13	E-technologies. Electronic business. E-learning. Electronic government.
14	Information technologies in the professional sphere. Industrial ICT.
15	Perspectives of ICT development.

1.2 Methodological instructions for Computation graphic paper №1

1.2.1 Title page of a document in MS Office Word 2007environment.

Open the application of MS Office Word 2007 program and create a new document, using the button «Create» at a tool bar. Set a ruler by means of the menu «View» (if it is absent) to display document margins and editing indents.

For making a title page, it is necessary to use the tab «Insertion» – «Title page» and choose one of offered templates.

Note. If none of templates is convenient, choose any other and then delete all unnecessary elements at sight. At the same time the format of the title page will remain.

To make a title page, according to the standard of making out AUPET graphic papers (Appendix A).

1.2.2 Make out the document text in MS Office Word 2007 environment.

1) The text of a report should be typed observing the following sizes of margins: left - 25 mm, upper - 20 mm, right - 18 mm and lower - 25 mm [1].

For editing the margin size, it is necessary to pass onto the «Page Marking panel» - «Margins» and choose a suitable one. Alternatively, to select «Set-up margins…» in the pop-up window of the same tab and customize to your requirements.

For quick transition to the menu of fields change «Page setup», it is possible to double click the left mouse button on a ruler (figure 1.1).

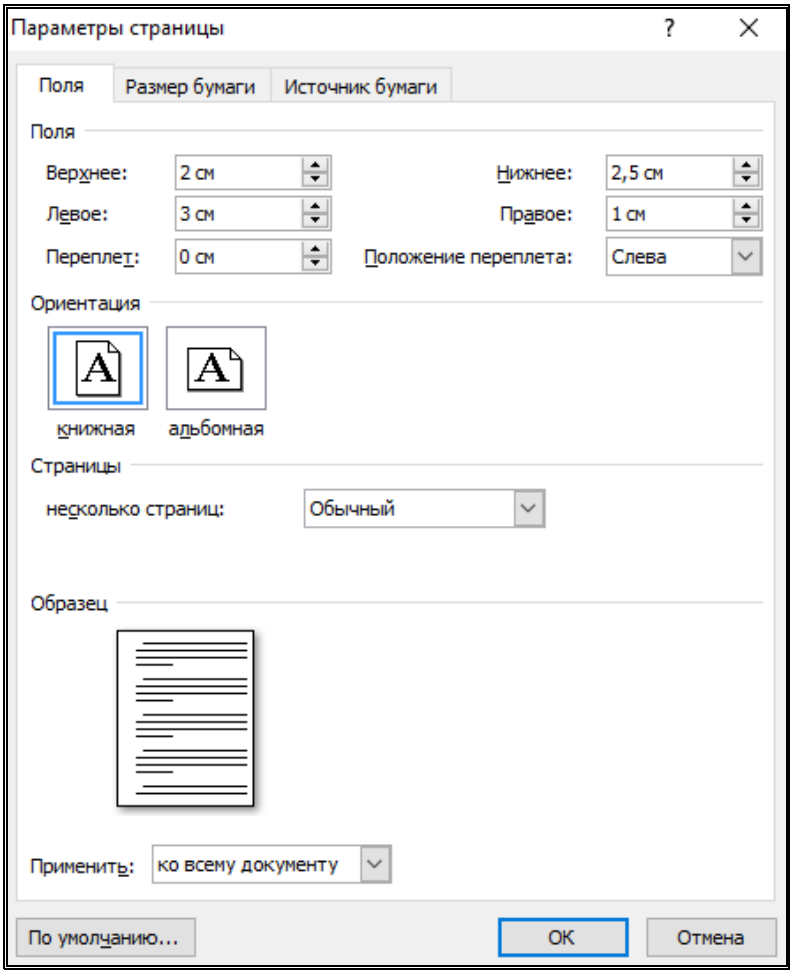

Figure 1.1 – Page setup

2) Page numbering is carried out on center and shall correspond to type size of a body text. For establishment of numbering it is necessary to select the Insertion tab – «Page headers» – «Number of the page» – «In the bottom of the page» – «Simple number 2» (figure 1.2).

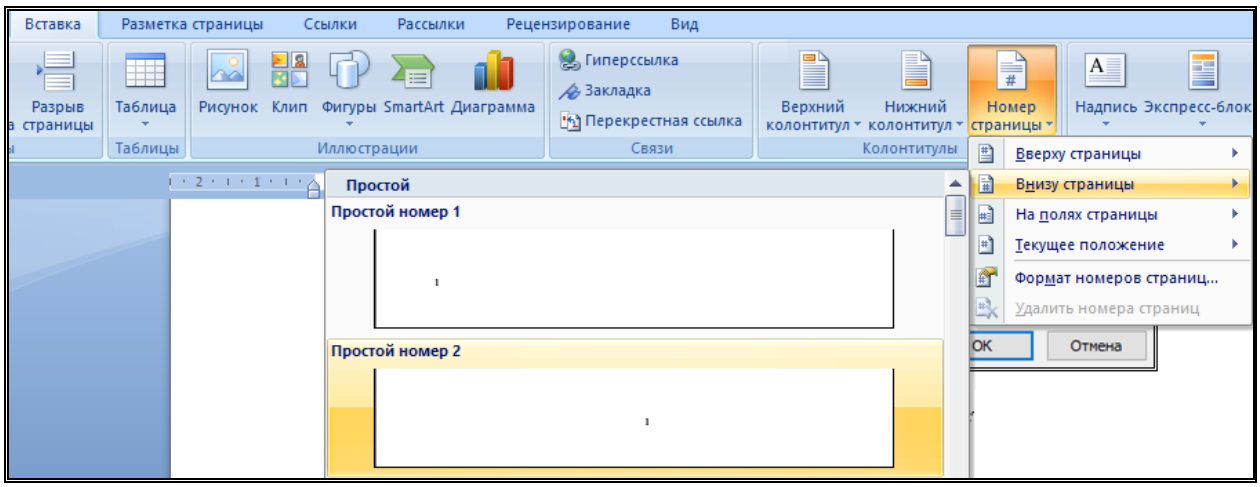

Figure 1.2 – Page numbering

To change the type size of page number it is possible to click twice across the field of a page header (on the page number), then the Operation with Page Headers tab will appear. To select the page number and apply the required type size and its type through the Principal tab – «Font».

3) Having been created the title page, edited margins and enumerated pages it is possible to save the file (the Office button – «To save as») and then pass to the formation of the report body text.

4) This computing graphic paper shall include the following elements:

– cover page;
– introduction;
– contents;
– main part;
– conclusion;
– list of references;
– applications (if necessary).

5) The document text shall be executed in the Russian (English) or Kazakh languages by a printed method based on a computer and printer on one side of a sheet of white paper of the A4 format (210x297 mm) in accordance with GOST 2.301. A font - Times New Roman, size 14, single space.

6) The distance between section and subsection headings makes two intervals. The distance between the title and text is one interval.

7) The size of a paragraph indent is standard (12,5 mm) and equal to five signs [1].

For editing line spacing it is necessary to use the Paragraph menu: the Principal panel - the Paragraph tab – «Line spacing» to choose 1,0. Alternatively, to remove additional functions and set single spacing (figure 1.3).

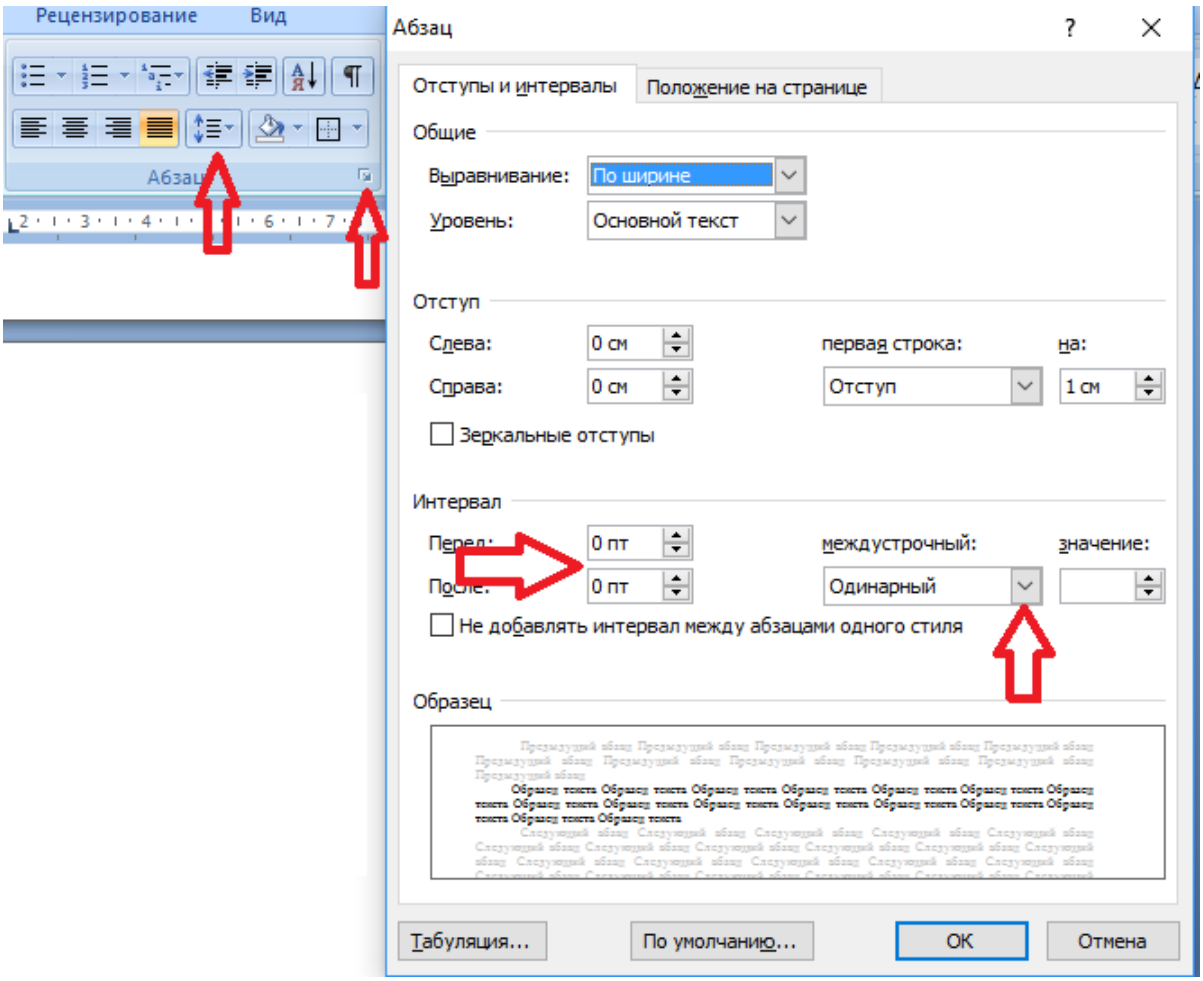

Figure 1.3 – Window «Paragraph»

1.2.3 Creation of an automatic table of contents (contents) and lists.

1) For creation of an automatic table of contents, it is necessary to use the «Links» tab – «Table of contents».

To select the name of the section in EGO and to appropriate level 1, for subsection level 2 (figure 1.4), i.e. in contents of the name of sections and subsections will be offset to the right.

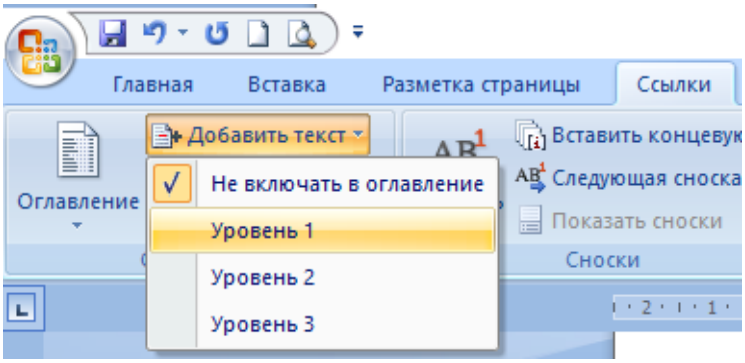

Figure 1.4 – Open menu of content table levels

To check that the body text was not included into a content table one should highlight the text and in the «Links» tab – «Table of contents» - «To add the text» set a tick onto «Not to include in a table of contents».

Having been appropriated all names of sections and subsections including Introduction, Conclusion and List of references to table levels it is possible to start its formation. For this purpose, select a template of a table of contents in the Links tab and insert it onto a single sheet of the document (figure 1.5). Further, it can be edited, according to requirements for making up documents (to change a font, type size, take out black or italic type).

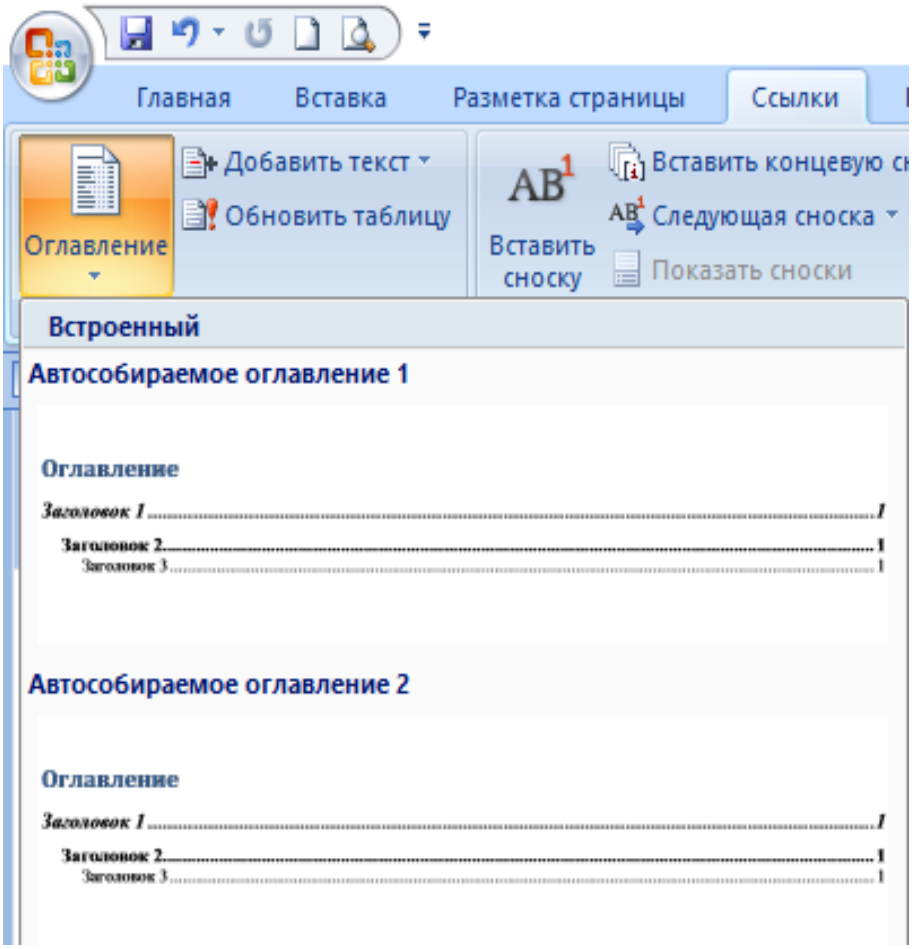

Figure 1.5 – Choice of a template of a table of contents

2) To create automatic lists it is necessary to use a tab «Principal» – «Paragraph». The lists can be: marked, numbering or multi-leveled (figure 1.6).

Listings in a text can be organized with a paragraph indent, which is used only at the first line. Before each line item of listing, it is necessary to put a hyphen.

If it is necessary to refer to one or several listings in the text, then before each line item instead of a hyphen put the lowercase letter given in alphabetical order, and after it the bracket.

For further extension of enumerations, it is necessary to use Arabic numerals, after which a bracket is placed, and their recording is made with a two-character

offset with respect to the enumerations indicated by the letters, as shown in the example.

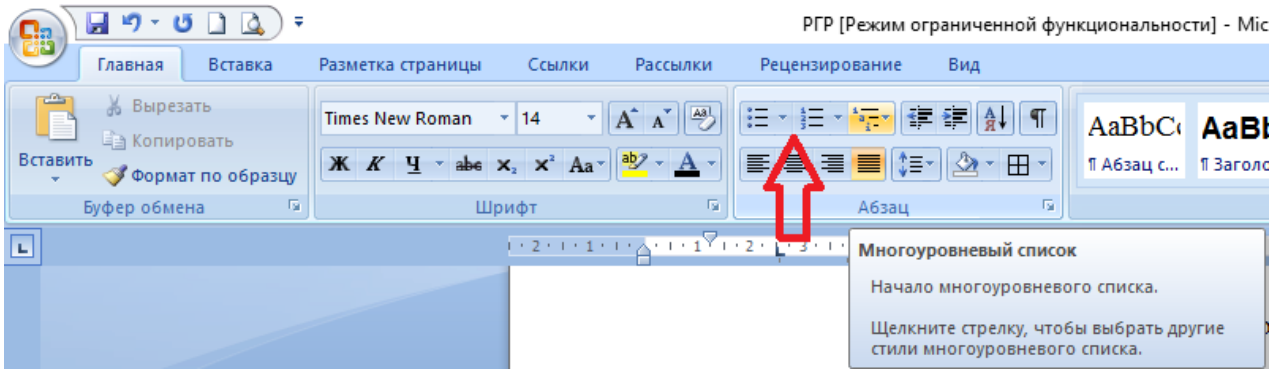

Figure 1.6 – Choice of a list of listing

Example:
a).....;
b).....;
  1)……..;
  2)……..;
c)……..

1.2.4 Making up formulas, figures and tables.

1) Each formula in the text shall be enumerated and made in compliance with the body text of a document (similar font and type size).

A formula is placed in the middle, numbering of formulas is carried out on the right edge of the document at the formula level in parentheses and can be either «open» (1, 2, 3, etc.), or within the section. In this case, the number of a formula consists of a number of section and a sequence number of the formula separated by a point. Numbering the formulas referenced in the text is required.

To insert a formula into the text of a document it is necessary to use «Insertion» tab – «Characters» – «Formula» and select from an offered list, or type the own one (figure 1.7).

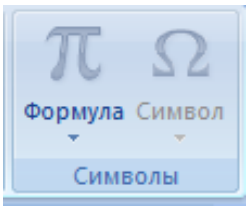

Figure 1.7 –«Characters» Tab for formula insertion

Example: Density of each sample p, kg/m, is calculated by the following formula:

$$p = m/V, \qquad (1)$$

where m is a sample mass, kg;

V - volume of a sample, m^3.

A comma separates formulas, following one by one and not partitioned by the text.

For example:

$$A=\frac{a}{b}\ ; \qquad (2)$$

$$B=\frac{c}{d}\ . \qquad (3)$$

2) Each figure in the document shall be enumerated and have the name. Numbering figures can be carried out within a section, or consecutive. The abbreviation of the word «Figure» is not allowed, numbering figures goes strictly after the word «Figure», and then the hyphen followed by a capitalized figure name.

Numbering the figures referenced in the text is required.

3) Tables are applied for the best visualization and convenience of indices comparison. Tables in the text are placed right after links to them or on the following page. At the left over the table it is necessary to place the word «T a b l e» with an uppercase letter with a letter spacing (3). After that, the number of the table is provided without a point at the end (tables 1, 3).

If there is more than one table in the text, then they are numbered with Arab digits within the document. Numbering tables within the section is allowed. In this case, the number of the table consists of a number of the section and sequence number of the table separated by a point.

All references of tables of the document shall be given in the text of the document; in case of the reference, it is necessary to write the word «Table» with its number.

The name of the table shall reflect its contents, be exact and short. It is written with an uppercase letter over the table after its number, separated by a dash without a point at the end.

If table lines or columns fall outside a page format, it is divided into several parts. In case of transfer of a part of the table to other pages, the name is placed only over the first part of the table, as for the other parts, «Continuation of the Table» is written with the number (italicized), «Termination of the Table» is given with the number (italicized) over the last part of the table. At the same time, the lower horizontal line limiting the table is drawn only at the termination of the table (table 1.2).

The column «№» is not included into the table, numbering indices is in the stub column (table 1.3).

The designation of a unit of physical quantity, general for all data in a line (column), one should specify after its name (table 1.4).

T a b l e *1.2*

Mo de	Voltage ,V	Cur rent, A
A	48	1,2
AB	36	0,8

Continuation of table 1.2

Mo de	Voltage, V	Cur rent, A
B	42	0,6
C	50	1,0

Termination of table 1.2

Mo de	Voltage ,V	Current, A
D	30	2,0

T a b l e 1.3 – Characteristics of operating modes

Index	Value		
	in mode 1	in mode 2	In mode 3
1 Current of commutator , A, no more	5	7	9
2 Voltage on a commutator, B	18, not less	22, not less	34, no more

For an insertion of the table, it is necessary to use the «Insertion» tab – «Table» and choose number of lines and columns. Then the table will appear in the text, further to edit it in compliance with requirements of making out a document (figure 1.8).

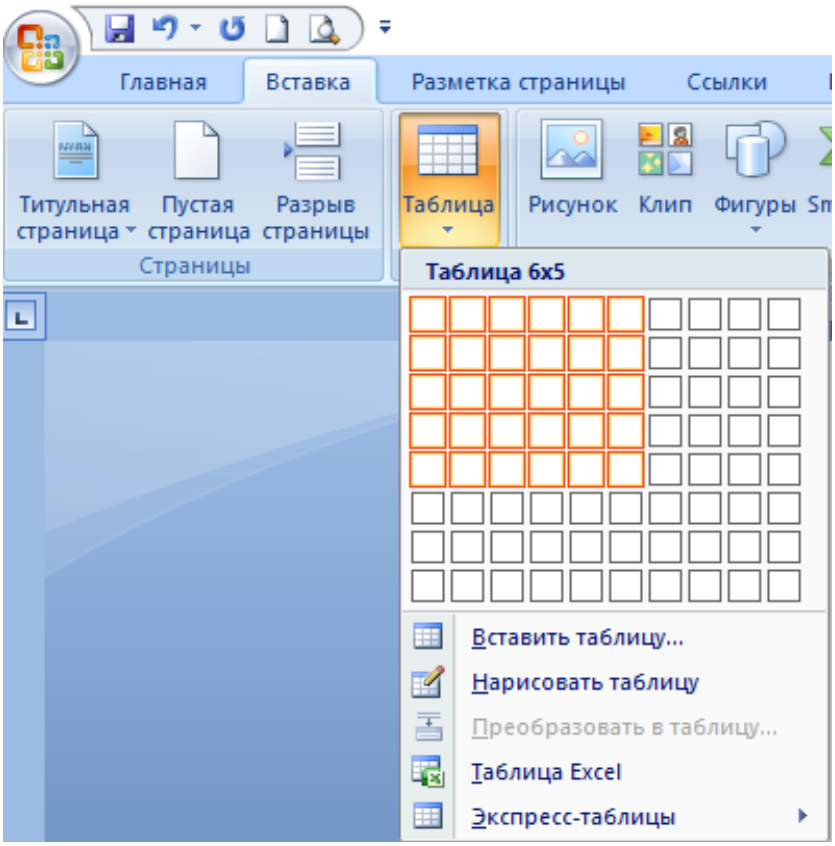

Figure 1.8 – Table Insertion

1.2.5 Making out a list of references.

The phrase «List of references» is made out as a title and not numbered, placed in the center of the sheet. Items in the list of references are arranged in order of their appearance in the text or in an alphabetical order.

Making reference to sources it is necessary to provide the sequence number according to the list of references concluded in square brackets in the text.

Numbering of the list of references is made out by Arab digits without point. Reference sources shall have the author's full name, the name of the book or article, etc., publishing house, year of release, number of pages, or the range of pages (for articles and reports, etc.).

1.3 Control questions

1. For what purposes is MS Word application program used?
2. How to create a new document, using the MS Word program?
3. How to set page parameters for a new document?
4. How to set a font, size and text color in a typed document?
5. How to make formatting of a typed text?
6. How is simultaneous work carried out with several documents in MS Word?
7. How to insert a figure or a text into the document?
8. How to create formulas using the MS Word program?
9. How to create a document title?
10. How to realize page numbering?

2 Computation graphic paper № 2. Creation of multimedia presentations by means of MS Power Point

2.1 Assignment

To create a presentation of the report on a chosen topic in CGP 1 (table 1.1) by means of MS Power Point.

2.2 Methodological instructions for Computation graphic paper №2

1) For creation of a presentation by means of MS Power Point 2007 it is necessary to Open the application of MS Office PowerPoint 2007 program: Start-up – Programs – Microsoft Office – Microsoft Office PowerPoint 2007.

The window of the program is presented in figure 2.1.

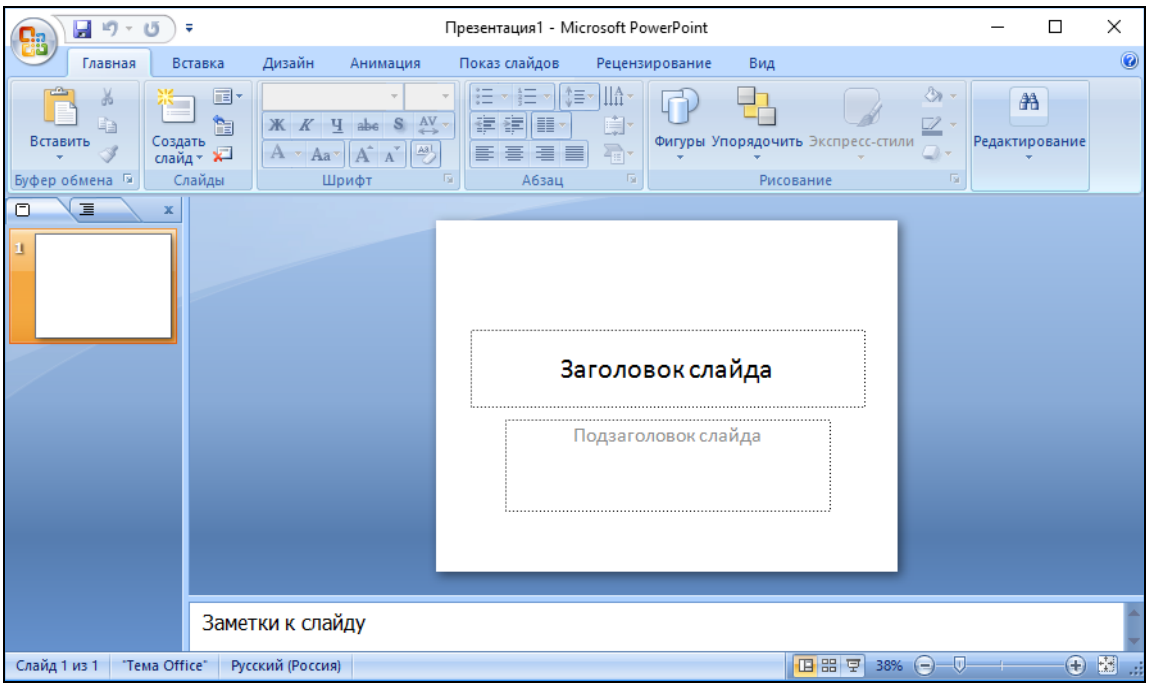

Figure 2.1 –PowerPoint 2007 Window

2) To choose the current slide of the presentation: the Main thing tab - the Slides group - the Prototype command. To choose a slide type from the Subject Office window - Empty slide (figure 2.2).

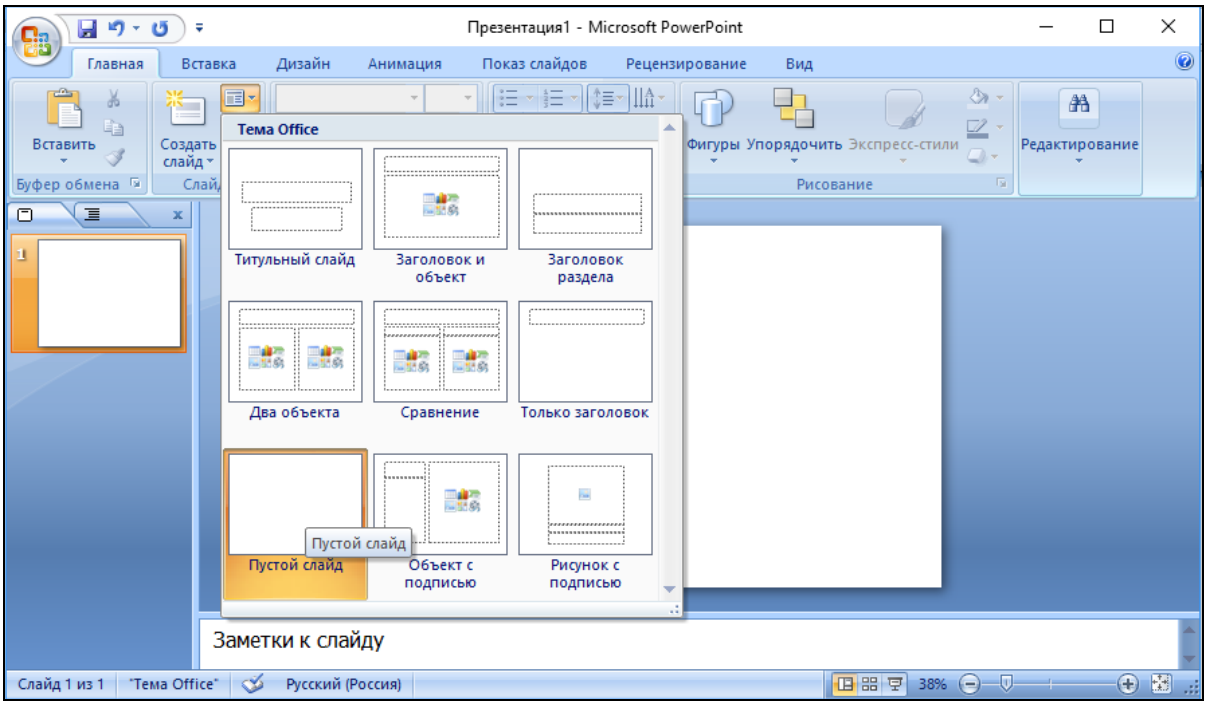

Figure 2.2 –Type of presentation current slide

3) It is possible to create a new slide or to delete it also through the Slides group (figure 2.3).

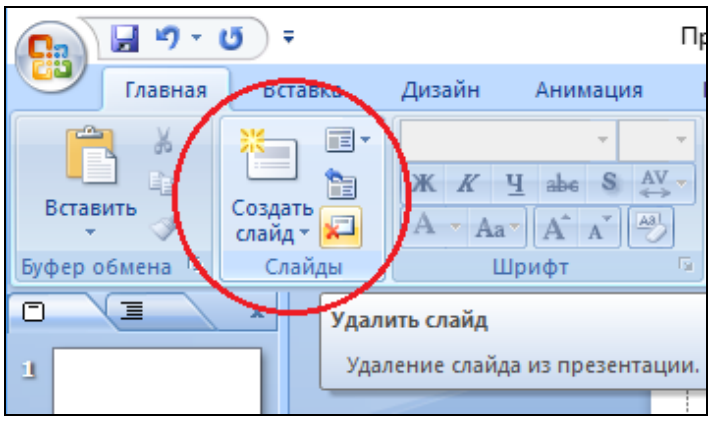

Figure 2.3 – Creation and deleting slides

4) It is possible to create a slide background in the Design tab by two methods:

The first method: choose a topic of slide design –Topic group. Having selected topics it is possible to change colors, fonts and effects (figure 2.4).

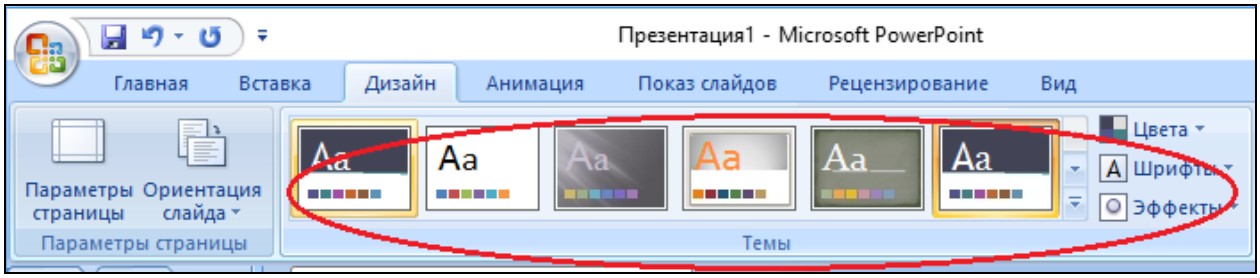

Figure 2.4 – Background topic

The second method: create your own background –Design tab - Background group - Styles of a Background command (figure 2.5).

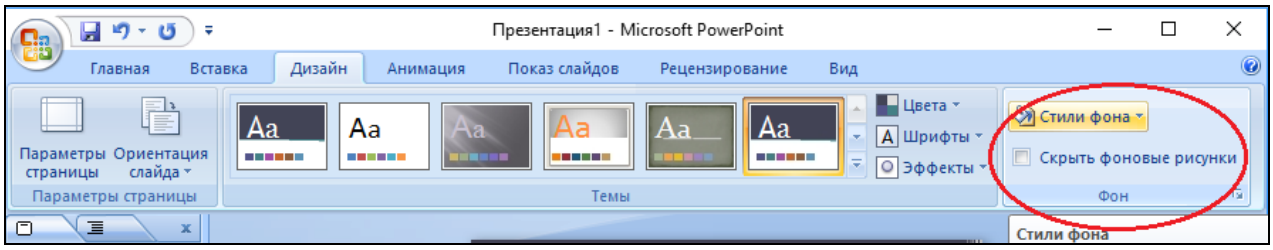

Figure 2.5 – Background styles

The format of a background is set up in Background Format window (figure 2.6) which is caused by Background Format command in Background Styles list. With its help, it is possible to choose filling type, its color, etc.

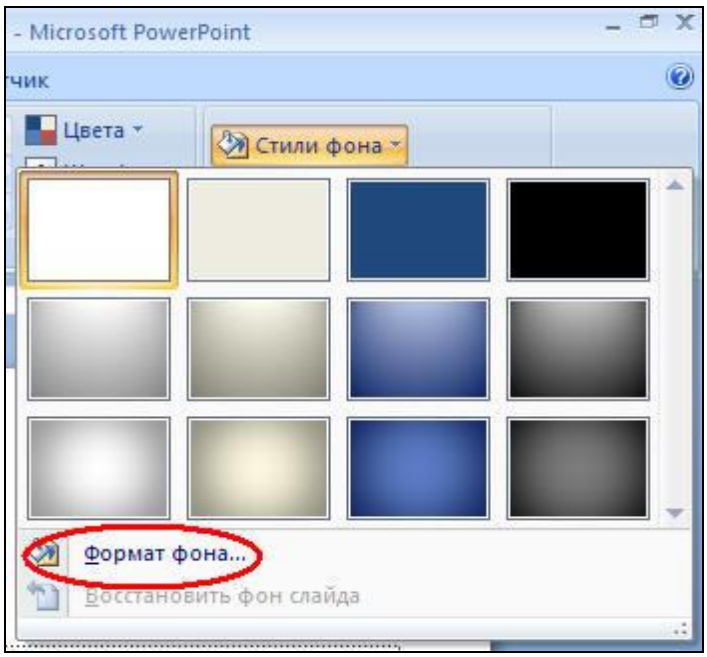

Figure 2.6 – Background Format

5) Text insertion into a slide (two methods):

The first method: Insertion tab – «Text» - «Text». Highlight with the cursor an area on the slide where the text will be typed, then type the text.

The second method: In the other document choose the text, copy it in a clipboard, pass to the presentation, insert on a slide the Text (highlight an area for the text) and insert the text from a clipboard, be sure so that the cursor was in the Text (figure 2.7).

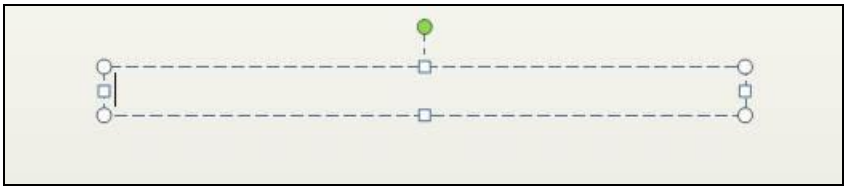

Figure 2.7 – Text insertion

6) Formatting a chosen text: the «Principal» tab - «Font» or «Paragraph» group:

– change of color –Text color command ;

– change of letter size – commands «Increase type size» or «Reduce type size» ;

– change of distance between lines - Line spacing command (figure 2.8);

– insert columns;

– change of text direction, etc.

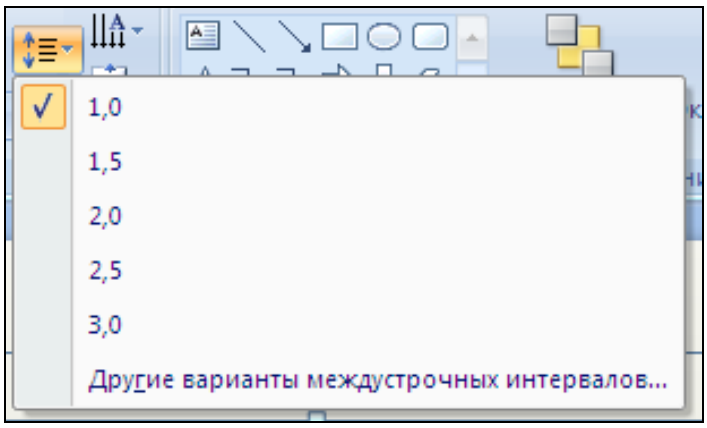

Figure 2.8 – Change of line spacing

It is possible to transfer an area with a text to another place if you select the area with a mouse and find such a cross ✥, then move the area with the mouse with the pressed left button.

It is possible to change t area size of of the text, having selected it with a mouse, having guided the cursor at one of 8 markers on area boundaries, having received a double arrow ⟷, move the cursor with the pressed left button.

7) Insertion of graphics images: Insertion tab - Illustrations group (figure 2.9). Then select the necessary command / button.

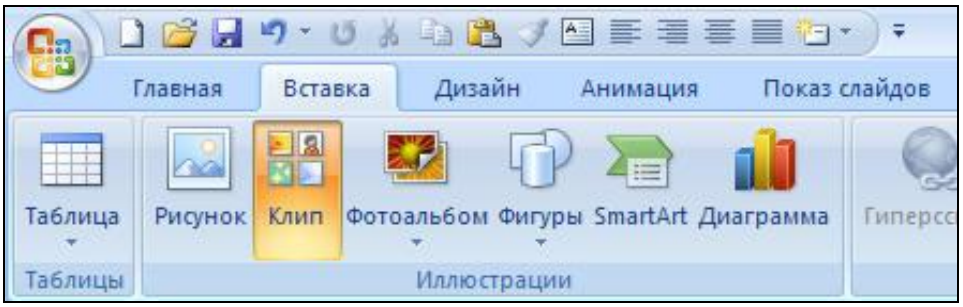

Figure 2.9 –Insertion of graphics images

The Figure button brings up Figure Insertion window where it is possible to select the file «Insert».

«Clip» button brings up the «Clip» area. In «View» type the keyword for searching pictures and press the «Begin» button. From output pictures select a necessary one and highlight it with a mouse.

«Figures» button allows creating a figure from standard lines and figures. Select a figure, transfer the cursor to a slide, select an area where the figure will be drawn.

It is possible to draw any figures, turn them, group (in case of the clicked SHIFT key, select all figures, the shortcut menu – group - to group). The selected figures can be formatted by means of tab commands «Means of drawing. Format» (figure 1.10).

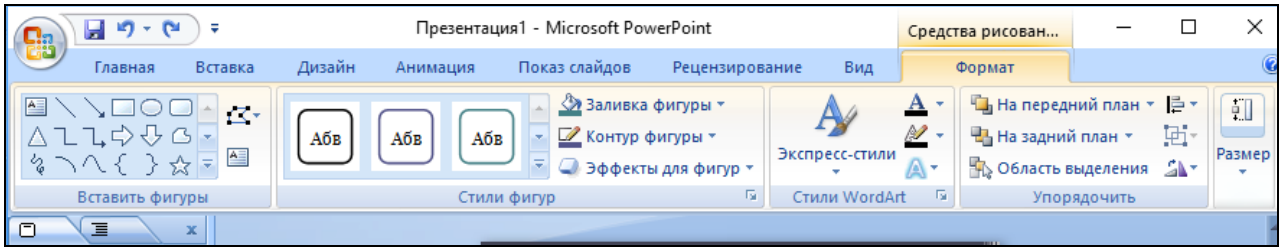

Figure 2.10 – Means of drawing

8) Setup of graphics images.

After separation of a graphic object, new Format tab will appear. Using commands of the Format tab, it is possible:

– to change figure brightness and contrast range;
– to recolor a figure;
– to change display style of a figure: form, boundaries, different effects;
– to cut off a part of a figure, turn a figure;
– to move a figure to the forefront or background (if there are several objects on a slide), etc.

9) Change of the sequence of following of slides: in the Slides area to select a slide and a mouse to draw it to the other place (figure 2.11).

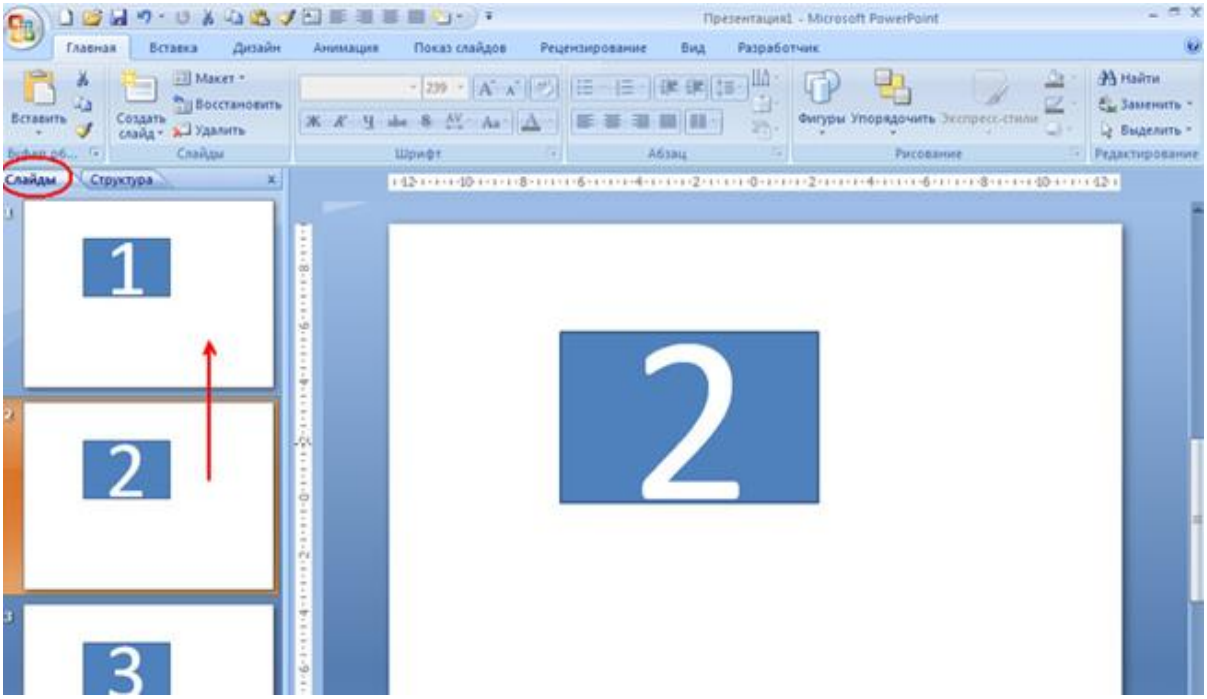

Figure 2.11 – Change of slide sequence

10) Animation setting of a selected object on the current slide: Animation tab - Animation group - Animation setting command (figure 2.12).

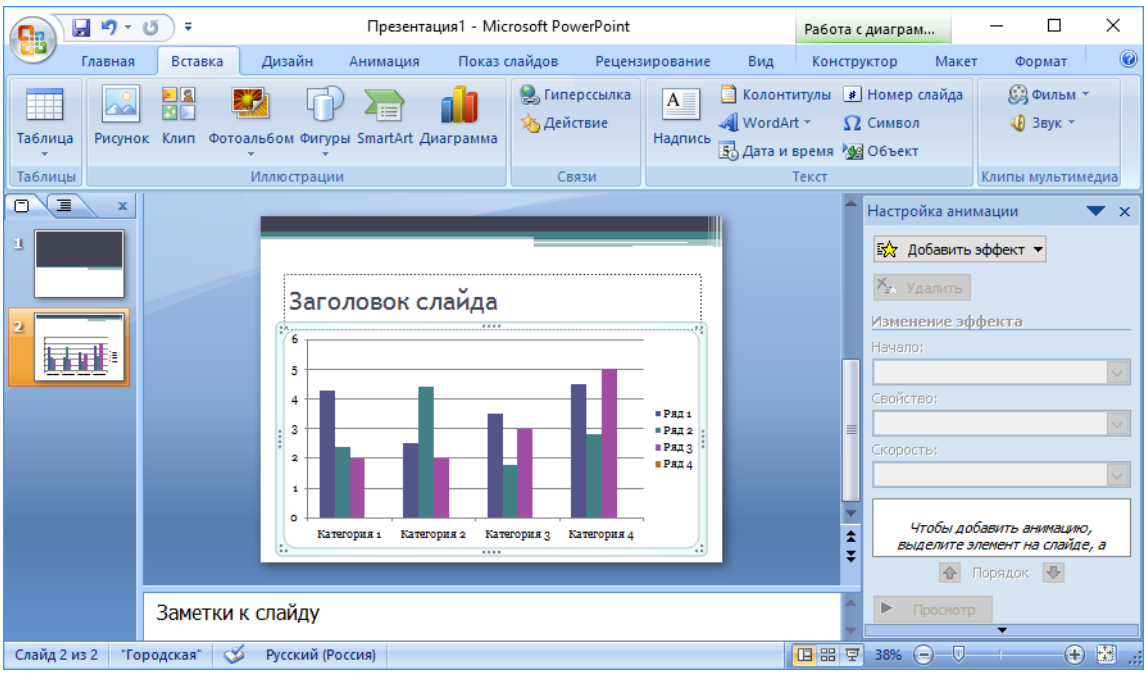

Figure 2.12 – Animation setting

From the Add Effect list, we select an effect for different objects from the Animation setting area. The sequence of execution can be changed by the animation in Animation Changes area, change the Beginning, Direction, and Speed.

11) Presentation viewing: Slide show tab - Begin Show group - Since the Beginning command (figure 2.13).

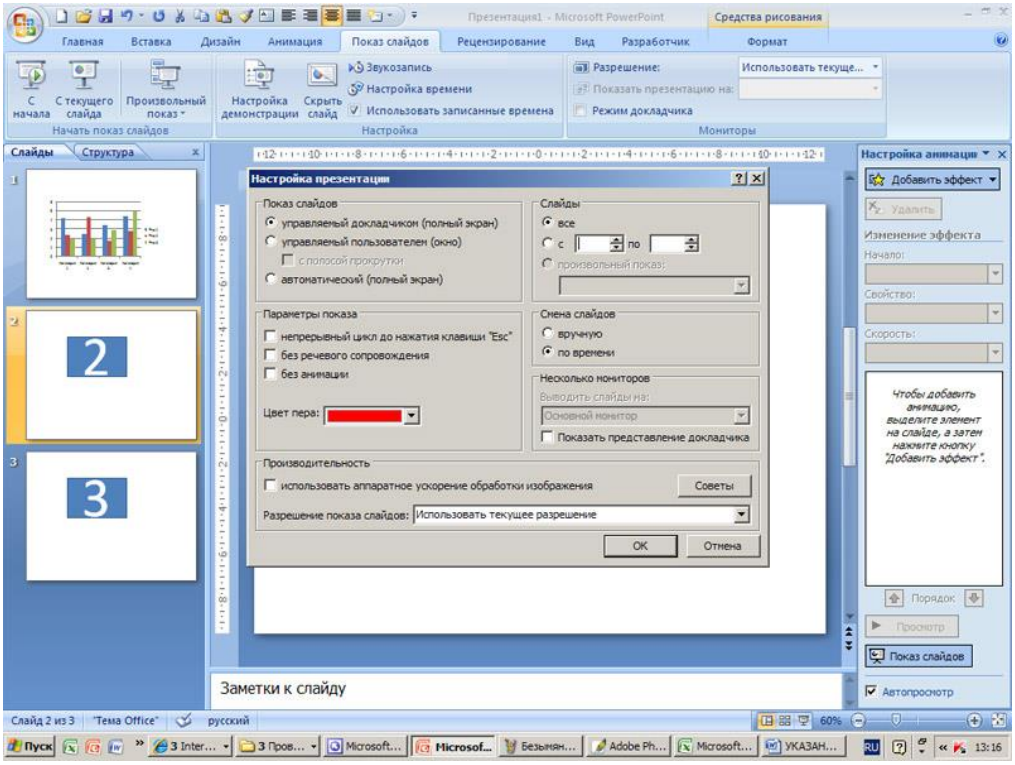

Figure 2.13 – Slide show

12) *Presentation saving* can be realized through the menu of the program, having pressed the button**.** . By means «Save as …» open Saving Document window, select the folder for saving and a presentation name, press the Save button.

13) Usability principles of a presentation.

The main objective of a presentation is to accompany the oral report and display the information, which is difficult to be presented orally. To increase the usability of presentations it is useful to follow the rules:

1) You should not write down on slides notes from the report to help listeners to be guided easier with the structure of submitted information.

2) Follow the rules of contrast range: primary color of the text and that of a background shall be rather contrasting among themselves. The brightness margin of the majority of modern projection devices is much lower than that of modern monitors; therefore, slides can look differently on these devices.

3) Use a uniform style: fonts Times New Roman, Verdana, Arial, Trebuchet MS are the most suitable for design of the presentation text;

4) Type size 54-44 pica will be suitable for titles. Type size 28-20 pica is convenient for texts inside the presentations. Each section shall have titles at least and differ obviously by the type size from the body text.

5) Text alignment: if the text holds several places, then in case of alignment «on the middle» every line is perceived separately therefore, it will be rather difficult to read such a text. In case of alignment «on the left edge» it will be most natural to read the text. Alignment «on the right edge» is read more difficult if reading is carried out from left to right. In case of alignment on width of texts with long words or in a narrow column, gaps and intervals are too different that also brings inconveniences when reading the text.

6) Layout of units of the text: the text is read standardly in the direction from left to right, from top to down, therefore the text of the separate units delivered in space will be read in such a sequence if there are no special visual indicators. The text shall not sink in a border; let it will be larger and more convenient. Do not superimpose the text with decoration elements or background.

7) You should not overload the presentation with graphics. Owing to certain features (for example, cultural) other people can perceive the same image differently than you expected that therefore, everyone should sign a figure (if necessary).

8) Avoid the use of illustrations not appropriate to the current topic and even more do not use images with opposite value.

9) Use charts, diagrams, graphs in presentation texts; it is convenient to display the logic of development of a thought, but it is inconvenient to describe a complex structure.

10) For the best understanding diagrams do not use more than 3-x curves on a single graph. It is optimum: 1 diagram -1 curve. It is possible to use on the 1st slide one curve, on the 2nd one - the 2nd curve, on the third one both. Also, do not forget about signatures.

11) Multimedia. The majority of software for presentations show is able to play video and gif-animation. It can be used for the display of operation of difficult systems.

12) The quantity of elements on a slide shall not exceed three. In extreme cases it may contain no more than 7.

13) The volume of text on a slide should not be more than 50 characters per line (7-9 words); reasonable maximum of words on a slide - 80. About 10 lines per slide. These numbers decrease with the increase of graphics.

2.3 Control questions

1. How to create a new document using MS Power Point program?
2. What is a computer presentation? How is it possible to create a new presentation?
3. What is a slide? What does it consist of?
4. How to add a new slide in a presentation?
5. How to delete a slide?
6. How to change an order of slides in a presentation?
7. How to change a background and colors on a slide?
8. What are the modes to browse a presentation ?
9. How to add a picture on a slide?
10. How to set up animation of objects on a slide?

3 Computation graphic paper № 3. IP addressing

3.1 Assignment

1. According to your variant, select an IP address and a mask of a network (table 3.1, 3.2).
2. Define the class of IP addresses.
3. Present a subnet mask in a decimal and binary form.
4. Calculate the quantity of hosts, subnets by the principle of class addressing; determine the range of each subnet, define the address of a packet purpose.
5. Determine the quantity and range of IP addresses in a subnet by the principle of classless addressing.

T a b l e 3.1 – Basic data

Last digit of the record book number	IP address / Subnet mask for class addressing	Subnet mask for classless addressing
0	59.124.121.36/27	255.255.128.0
1	124.52.45.126/25	255.255.192.0
2	12.125.35.165/24	255.255.128.0

T a b l e 3.1 – Basic data

Last digit of the record book number	IP address / Subnet mask for class addressing	Subnet mask for classless addressing
3	219.2.5.92/26	255.255.0.0
4	205.2.5.45/28	255.255.224.0
5	112.2.5.125/29	255.255.255.0
6	26.2.100.25/24	255.255.240.0
7	223.2.56.121/25	255.240.0.0
8	224.6.5.128/27	255.198.0.0
9	198.125.35.168/30	255.255.0.0

3.2 Methodological instructions for Computation graphic paper № 3

3.2.1 Bases of representation of IP addresses and subnet masks.

IP addresses are used to identify devices in a network. For interaction in the network IP address shall be assigned to each network device (including computers, servers, routers, printers, etc.). Such devices in a network are called hosts.

By means of a subnet mask, the greatest possible number of hosts on a specific network is defined. Subnet masks allow dividing one network into several subnets.

An IP address consists of four bytes written in the form of decimal numbers with points (for example, 192.168.1.1). Each of these four parts is called an octet. An octet represents eight binary figures (for example, 11000000, or 192 in a decimal notation). Thus, each octet can accept values from 00000000 to 11111111, or from 0 to 255 in a decimal notation in a binary type:

128.10.2.30 is a traditional decimal form of representation of an address,

10000000 00001010 00000010 00011110 is a binary form of representation of the same address. The structure of the IP address is shown in figure 3.1.

Class A

0	N network	N node

Class B

1	0	N network	N node

Class C

1	1	0	N network	N node

Class D

1	1	1	0	group address multicast

Class E

1	1	1	1	0	reserved

Figure 3.1 – Structure of an IP address

The address consists of two logical parts – network numbers and numbers of a node on a network. Which part of the address belongs to network number and which one to the number of a node it is defined by values of the first bits of the address:

– if the address begins with 0, then the network is referred to class A, and the network number occupies one byte, remaining 3 bytes are interpreted as a number of a node in the network. Number class networks in the range from 1 to 126. (Number 0 isn't used, and number 127 is reserved for the special purposes what it will be told below about.) The quantity of nodes shall be more than 216, but not exceed 224 in networks of class A;

– if the first two bits of the address are equal to 10, then the network belongs to class B and is a network of average sizes with the number of nodes 28-216. In the networks of class B the network and node address is assigned 16 bits each, that is by 2 bytes;

– if an address begins with 110, then it is a network of class C with number of nodes no more than 28. The network address is assigned 24 bits, and node address - 8 bits;

– if the address begins with the sequence 1110, then it is the address of class D and designates a special, multicast address — multicast. If in a packet as the address of assignment the class D address is specified, then all nodes to which this address is appropriated shall receive the packets;

– if the address begins with sequence 11110, then it is the address of class E, it is reserved for future applications.

The ranges of numbers of the networks corresponding to each class of networks are given in table 3.3.

T a b l e 3.3 – Ranges of numbers of networks

Class	The smallest address	The greatest address
A	0.0.0.0	127.0.0.0
B	128.0.0.0	191.255.0.0
C	192.0.1.0.	223.255.255.0
D	224.0.0.0	239.255.255.255
E	240.0.0.0	247.255.255.255

The quantity of binary figures in an IP address which fall on network number and the number of digits in the address falling on a host identifier can be different depending on a subnet mask.

The subnet mask is used for determination of which bits are a part of network number and which ones – a part of a host identifier (logical action of conjunction is for this purpose applied – «And»).

The subnet mask includes 32 bits. If a bit is equal to «1»in a subnet mask, then the appropriate bit of the IP address is a part of network number. If the bit is

equal to «0» in a subnet mask then the appropriate bit of the IP address is a part of a host identifier.

The subnet mask selecting network number (bold-face type) and a host identifier in the IP address is shown in table 3.4 (which in a decimal look registers as 192.168.1.2).

Subnet masks always consist of a series of sequential units, since the most left bit of a mask which a series of sequential zero making in total 32 bits follows.

T a b l e 3.4 – Example of marking the network number and host identifier in an IP address

	1-st octet: (192)	2-nd octet: (168)	3-rd octet: (1)	4-th octet: (2)
IP address	11000000	10101000	00000001	00000010
Subnet mask	11111111	11111111	11111111	00000000
Network number	11000000	10101000	00000001	
Host identifier				00000010

The subnet mask can be defined as a number of bits in the address representing a network number (the number of bits with value 1). For example, a mask is called «a 8-bit mask» in which 8 bits are single, and remaining 24 bits – zero.

T a b l e 3.5 – Subnet masks

	Binary 1-st octet:	Binary 2-nd octet:	Binary 3-rd octet:	Binary 4-th octet:	Decimal
8-bit mask	11111111	00000000	00000000	00000000	255.0.0.0
16-bit mask	11111111	11111111	00000000	00000000	255.255.0.0
24-bit mask	11111111	11111111	11111111	00000000	255.255.255.0
29-bit mask	11111111	11111111	11111111	11111000	255.255.255.248

The quantity of discharges in a network number determines the maximum quantity of hosts, which can be in such a network.

The more bits are in a network number, the less bits remain on a host identifier in the address.

T a b l e 3.6 – Greatest possible number of hosts

Subnet mask		Host identifier size		Maximum quantity of hosts
8 bit	255.0.0.0	24 bit	$2^{24} – 2$	16777214
16 bit	255.255.0.0	16 bit	$2^{16} – 2$	65534
24 bit	255.255.255.0	8 bit	$2^{8} – 2$	254
29 bit	255.255.255.248	3 bit	$2^{3} – 2$	6

As the mask is always the sequence of units at the left added by a series of zeroes up to 32 bits it is possible just to specify the quantity of units, but not to write value of each octet. Usually it is written as «/» after the address and number of single bits in a mask.

For example, the address 192.1.1.0/25 represents the address 192.1.1.0 with a mask 255.255.255.128.

Some possible subnet masks in both formats are shown in table 3.7.

T a b l e 3.7 – Alternative format record of a subnet mask

Subnet mask	Alternative record format	Last octet (in a binary view)	Last octet (in a binary view))
255.255.255.0	/24	0000 0000	0
255.255.255.128	/25	1000 0000	128
255.255.255.192	/26	1100 0000	192
255.255.255.224	/27	1110 0000	224
255.255.255.240	/28	1111 0000	240
255.255.255.248	/29	1111 1000	248
255.255.255.252	/30	1111 1100	252

3.2.2 Class addressing.

By means of subnets, it is possible to divide one network into several ones. In the example given below the network administrator creates two subnets to isolate a server group from remaining devices for the safety purpose.

In this example, the network of company has the address 192.168.1.0. The first three octets of the address (192.168.1) represent the network number, and the remained octet – a host identifier that allows using at most 28 - 2 = 254 hosts in the network. The network of the company before its division into subnets is shown in figure 3.2.

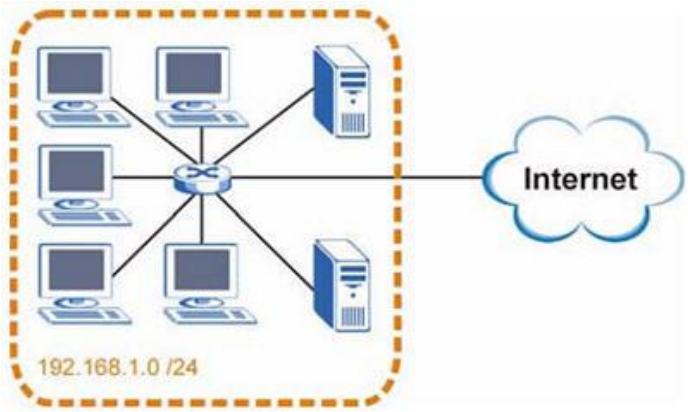

Figure 3.2 – Example of subnets formation: before division into subnets

To divide network 192.168.1.0 into two separate subnets, it is possible «to borrow» one bit from a host identifier. In this case the subnet mask will become 25-bit (255.255.255.128 or/25).

The «lent» bit of the host identifier can be either zero or a unit that gives us two subnets: 192.168.1.0/25 and 192.168.1.128/25.

The network of company after its division into subnets is shown in a figure 3.3. Now it includes two subnets: A and B.

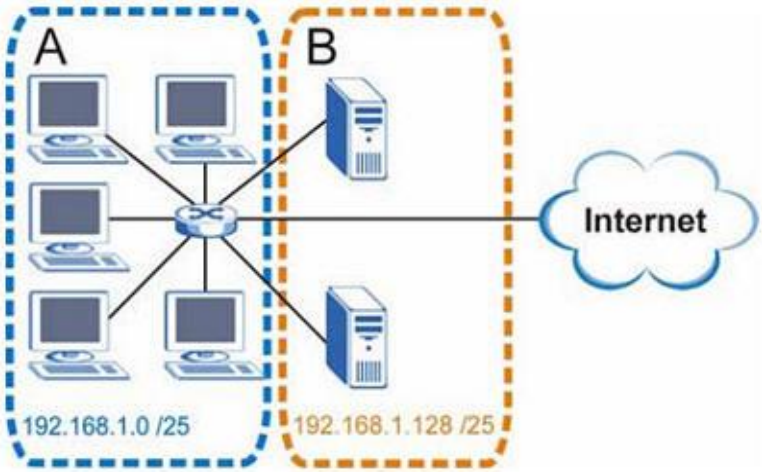

Figure 3.3 –Example of subnets formation: after division into subnets

There are 7 bits in a 25-bit subnet; therefore in each subnet there can be at most 27 - 2 = 126 hosts are selected for a host identifier (the host identifier from all zero is a subnet, and from all units – a broadcast address for a subnet).

Address 192.168.1.0 with mask 255.255.255.128 is the address of a subnet And 192.168.1.127 with mask 255.255.255.128 is its broadcast address. Thus, the smallest IP address which can be assigned to the valid host in subnet A is 192.168.1.1, and the greatest – 192.168.1.126. Similarly, the range of host identifiers for subnet B makes from 192.168.1.129 to 192.168.1.254.

The example of calculation of quantity of subnets and hosts in a subnet based on the IP address and a subnet mask for network 59.124.163.151/27.

/27 - prefix of a network or network mask

In the format of binary numbers 11111111 11111111 11111111 11100000

In the format of decimal numbers 255.255.255.224.

In the fourth field (the last octet), 11100000 first 3 bits define number of subnets, in our example 23 = 8.

In the fourth field (the last octet), 11100000 last 5 bits define number of hosts of a subnet, in our example 25 = 32.

The range of IP of the first subnet 0 ~ 31 (32 hosts), but zero is a subnet number, and is 31 Broadcast. Thus, the maximum number of hosts of this subnet is 30.

The first subnet: 59.124.163.0.

Broadcast of the first subnet: 59.124.163.31.

The range of IP of the second subnet with 59.124.163.32 on 59.124.163.63.

The second subnet: 59.124.163.32.

Broadcast of the second subnet: 59.124.163.63.

We can calculate the range of IP of the eighth subnet with 59.124.163.224 on 59.124.163.255.

The eighth subnet: 59.124.163.224.

Broadcast of the eighth subnet: 59.124.163.255.

In our example, the IP address 59.124.163.151 is in the fifth subnet.

The fifth subnet: 59.124.163.128/27.

The range of IP of the fifth subnet with 59.124.163.128 on 59.124.163.159

Broadcast of the fifth subnet: 59.124.163.159.

3.2.3 Address determination of a packet assignment.

IP protocol uses the operation of logical «And» to determine to what node the packet located on the local or remote area network is intended. IP address of a node develops with its subnet mask by means of logical «And». Before sending each IP packet, the assignment IP address develops with the same subnet mask in the same way. If results of two mentioned above operations match, it means that the receiver of the packet is in a local area network. Otherwise, the packet goes to a router IP address.

T a b l e 3.8 – Logical operation «And»

Comparison of bits	Result
1 «And» 1	1
1 «And» 0	0
0 «And» 0	0
0 «And» 1	0

IP address:	10011111 11100000 00000111 10000001
Subnet mask:	11111111 11111111 00000000 00000000
Result:	10011111 11100000 00000000 00000000

3.2.4 Classless addressing allows controlling flexibly a limited IP address space, by means of application of different masks of subnets to different subnets. For calculation of classless addressing, it is necessary to transfer a mask and subnet number to a binary form:

– subnet number: 26.219.128.0 – *00011010.11011011.10*000000.00000000;

– subnet mask: 255.255.192.0 – *11111111.11111111.11*000000.00000000.

The number of zero in a subnet mask allows defining a total quantity of nodes (addresses) in a network. If we designate the number of zero by K, then the quantity of nodes is defined as 2^K - 2, i.e. one address is the address of multiple address mailing, and the second one is the address of the very network.

In the example of K=14 (all zero in a subnet mask), therefore:

2^K - 2 = 16381 addresses.

To determine the range of IP addresses it is necessary to find an initial and finite IP address of a subnet. For this purpose, let us select those bits, which are equal to one unit in a subnet mask in subnet number. These are ranks, which are responsible for subnet number, and they will match for all nodes of this subnet, including initial and finite:

– subnet number: 00011010. 11011011. 10000000. 00000000;

– subnet mask: 11111111. 11111111. 11000000. 00000000.

To receive the initial IP address of a subnet, it is necessary to use zeroes for the selected bits in subnet number, except the last one, which shall be equal to a unit. The received address will be the first of admissible addresses of the range of a subnet. Initial subnet number:

00011010. 11011011. 10*000000. 00000001* – 26.219.128.1

To receive a finite IP address of a subnet, it is necessary to fill the selected bits in subnet number with units, except the last one, which shall be equal to zero. The received address will be the last one of admissible addresses of the range of a subnet. Finite subnet number:

00011010. 11011011. 10*111111.11111110* – 26.219.191.254

For a subnet with number 26.219.128.0 and a mask 255.255.192.0 quantity of possible addresses: 16 382, and range of possible addresses: 26.29.128.1-26.219.191.254.

3.3 Control questions

1. What is IP address?

2. What is a subnet mask?
3. How to calculate the quantity of nodes for class addressing?
4. How to calculate the quantity of nodes for classless addressing?
5. How does class addressing differ from classless addressing?
6. What is a disadvantage of class addressing?
7. How to define class IP addresses?
8. How many address classes exist? What is their purpose?
9. How to define the address of assignment of a packet?
10. How to define the range of possible addresses in classless and class addressing?

Application A

Sample of the cover page of a calculation graphic paper

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Advisor_____
(academic degree, rank, Name.)
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