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“МАГІСТР”**

Тема: «Застосування апаратно-програмних засобів навчання технічного персоналу авіакомпанії з авіоніки»

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“ _____ ” _____ 2022

GRADUATE WORK

(EXPLANATORY NOTE)

GRADUATE OF EDUCATIONAL AND QUALIFICATION

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"MASTER"

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TASK

Viktor Konoval

1. Topic of the thesis: «Application of hardware and software tools for training airline technical staff in avionics», approved by the rector's order from «13» September 2021 №1413/CT.

2. The term of the work: from 05.09. 2022 to 30.11.2022.

3. Initial data for work: the internal structure of the cabin of the regional aircraft and its equipment

4. Contents of the explanatory note (list of issues to be developed):

GENERAL STATEMENT OF REQUIREMENTS FOR ONLINE LESSONS
Analysis and justification of the choice of hardware and software. Justification of the methods of conducting educational classes. Experimental conduct of online classes. Labour protection. Environmental protection.

5. A list of mandatory graphic material (with a precise definition of mandatory drawings, diagrams, tables, etc.). Table of equipment characteristics, workplace diagrams, workplace ergonomics, equipment location and its example, footage from the online class.

6 . Calendar plan-schedule

№ п/п	Task	Deadline	Performance note
1	Comparative analysis of existing methods and recommendations for conducting online lessons with airline	01.10.2021	
2.	Study of online learning platforms and software packages	12.05-20.05	
3	Justification of choice of learning hardware and softwar	05.09-09.09	
4.	Development of the methodology for conducting the training process with airline	12.09-16.09	
5.	Experiment	19.09-30.09	
6.	Conducting a practice lesson with airline personnel	03.10-07.10	
7.	Labour protection	10.10-20.10	
8.	Environmental protection	24.10-28.10	
9.	Preparation of graphic material	01.11-04.11	
10.	Issuance of an explanatory note	07.11-11.11	
10.	Presentation to the department. Elimination of deficiencies, preparation of an explanatory note	14.11-30.11	

11.	Preparation for review	14.11-30.11	
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7. Consultants from individual departments

Section	Consultant (post, Name)	Date, signature	
		Issued the task	I accepted the task
Labour protection	Kateryna Kazhan		
Environmental protection	Lesya Pavlyukh		

8. Issue date of the assignment: «____» _____ 2022.

Supervisor of the thesis _____

Valery BELINSKI

The task took to perform _____

Viktor KONOVAL

ABSTRACT

Explanatory notes to bachelor work 'Application of hardware and software tools for training airline technical staff in avionics' contained 94 pages, 70 figures, 10 tables, 31 references.

Keywords: AIRPLANE, COMPUTER, MOBILE PHONE, WEB-CAMERA, ONLINE CLASS, PRACTICE CLASS, VIDEO, MICROPHONE, AIRLINE STAFF, APPLICATION, WORKPLACE, DISTANCE EDUCATION.

Object and subject of research – using a camera in online lessons, creating a workplace for holding an online conference, studying new methods of conducting practice lessons, personnel training methods, work and maintenance of computer equipment.

Purpose of master work – explore new, distance learning methods and business meetings with airline personnel.

Research Method – the double team-ideation method, the methods of decision-making theory, reliability theory, market analysis method, statistics theory, information theory and the method of expert assessments were used.

Scientific novelty – methods of new use of television equipment, as well as their components, recommendations and methods of using the equipment when using and their general impact on the educational system are proposed.

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LIST OF ABBREVIATIONS

Webcam	Web-camera
PC	Personal Computer
Micro	Microphone
Wi-fi	Wireless Network
App	Application
VAS	Voice Activated Switching
AT	Aviation technique
AS	Airline Staff
CA	Civil Aviation
AES	Aviation Engeneering Service
TM	Technical Maintenance
ETP	Engeneering Technical Personel
EAS	Enhanced Avionics System
ATA	Advanced Technology Attachment
DAU	Data Acquisition Unit
FD	Flight Decoder
PTZ	Pan, Tilt and Zoom camera

INTRODUCTION

Conducting classes remotely, not being able to explain in person and help at the time of the problem - a new problem that we encountered 3 years ago, and could not imagine such situations in our work. But war and pandemic contributed unexpected adjustments and forced everyone to urgently master digital tools and new pedagogical approaches and techniques.

Forced distance learning has become a challenge for everyone participants in the educational process both for coaches and airline staff.

Organize quality training using digital technologies, motivate, give advices to technical problems was not easy.

Distance learning is an individualized process of acquiring knowledge, skills, abilities and ways of human cognitive activity, which occurs mainly through the indirect interaction of distant participants in the training process in a specialized environment that operates on the base of modern information and communication technologies.

Distance learning involves access to the Internet, technical support (computer, tablet, smartphone, etc.) for all participants in the educational process, as well as the fact that leader of have lessons distance learning technologies.

In this explanatory note, guidelines consist of four chapters:

The first section contains an analysis of the literature, which will be used later

In the second chapter the general principles of theoretical preparation for distance education.

The third chapter provides information on tools and platforms on which to learn remotely.

The fourth chapter is devoted to specific methods of developing a distance learning workplace.

The fifth chapter contains information about using the Google Classroom application and conducting a distance lesson using this program.

The sixth section provides an example of conducting a practical training for those personnel.

The seventh section talks about safety precautions during work.

The eighth section contains safety precautions for work, to predict and neutralize environmental damage.

The generalized experience of almost three years distance learning, so this experience all of us still needed for continue studying, working and teaching.

In addition, the world is becoming more mobile, education is becoming more individualized and flexible; therefore, new and new reasons arise every day for the need to have distance learning skills.

These guidelines will be useful in teaching, with which you will gain new knowledge, habits, and practical skills.

CHAPTER 1

COMPARATIVE ANALYSIS OF EXISTING METHODS AND RECOMMENDATIONS FOR CONDUCTING ONLINE LESSONS WITH AIRLINE PERSONNEL

1.1 Analysis of the selection of recommended literature regarding the selection of equipment.

Nowadays, the ways and methods of conducting online classes seem completely identical and understandable to everyone, but this is not so. The task is to choose the right methodology, equipment and resources necessary and sufficient to conduct a specific type of class, which will ensure the quality and feasibility of the class. Identifying specific factors and features of each type of training can help in solving the issue of making training more effective and more accessible for both students and teachers. Among such factors are the speed of communication, the quality of image and sound, the type of presentation of the lecture or practical material, the possibility of performing additional tasks during the class.

First of all, it is necessary to analyze our actions to prepare the educational process. Source (5) describes the method of approaching this issue: prepare equipment for conducting online classes, choose software that will suit our needs and requirements in online teaching or training, adapt the face-to-face program into a program that will be taught using the Internet and ensure quality with connection to this network.

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In my opinion, this is the right comprehensive approach, which will save resources and be as effective as possible in preparing for the educational process, which will ensure a full course of study, according to the curriculum and enable students/students to receive the full amount of knowledge regardless of obstacles.

In order to clearly understand the quality of the image transmitted by the camera, there is a method that was developed on the basis of a laboratory study, which is described in source (4) for testing the image of a video camera, for which there is a stand, a camera, a line of tripods and a special text table that shows color charts and a sharpness ruler to capture the data and compare it to the original, the better the color match and the sharper the lens image, the better the camera.

In order to make sure that the quality of the sound recorded by your microphone is sufficient and does not have extraneous noise, you can use the built-in voice recorder on your device, for this it is enough to select the device that will be tested in the settings and record a short voice message with the volume of the voice first with the window and door closed and then with the open, this procedure is to understand how sensitive the microphone is to normal ambient noise, more details about this method of analysis can be read in the source (6).

As indicated in source (1), with a screen size of 17", the distance between the head and the screen should be at least 1.8m, and for a computer 0.6m. This distance is recommended for long-term viewing of the screen and does not significantly affect the quality of vision over time, which is very important, since myopia is a professional disease of scientists.

1.2 Analysis of the literature on the choice of educational methods.

Depending on the type of training with airline personnel, there are different criteria and requirements for conducting it. Conducting a lecture or seminar should take 90 minutes, for it is recommended to have a good Internet connection and to have quality devices for playing and recording sound, the camera is rarely used during such classes, so its presence is not required. For practical tasks, it is not so important how much time was spent on showing the material, what is important is its brevity, comprehensibility, and the meaningfulness of the topic presented to the listeners. For lecture or seminar meetings, you need to equip a workplace for the leader of the meeting. It can be an office in an airline office, an apartment at home, a hotel room if it is a business trip, etc.

The recommendations and basic principles regarding the arrangement of an ergonomic workplace indicated in the source (7) are quite practical. We can only add that the following list of equipment that will be used for online classes is necessary for full-fledged work, namely: a computer, two monitors, a mouse, a keyboard, headphones, a microphone, two cameras, a table, a chair, an educational board for drawing diagrams or what, cable/router for internet connection.

On the contrary, a high-quality image is necessary in a practical lesson. During such a class, video material on a specific topic can be shown, or online material presented by the teacher, which will be performed during the class. It can be a demonstration of the operation of some device or system, a scientific experiment, a step-by-step instruction on the maintenance of aircraft equipment, its repair or modernization. Also, an option for conducting a practical lesson is to conduct it on an airplane, showing the complete process of assembling or disassembling aircraft equipment, its maintenance according to the regulations.

For this type of classes, you need to have additional equipment - a tripod with a camera, as well as a wireless microphone with headphones, this will ensure high noise immunity and allow the teacher to conduct classes in the room where

the work is being conducted. The tripod should be three-legged with a rotating foot, for convenient adjustment of the angle and the sector that will be captured for shooting.

After choosing the equipment and the priority speed of the Internet connection, you should choose the software through which the classes will be held.

Among the many programs used, only a few of them have gained the most popularity, namely: Google Classroom and Zoom. Since the classes include the study of lecture material, the opportunities provided by Zoom are not enough for a full course of study. Therefore, in the future, we will only use the Google Classroom program, in which it is possible to share educational material and conduct video-audio meetings, as well as conduct tests and give homework. Also, this program is recommended for conducting classes in general, educational institutions of the Ministry of Education and Culture of Ukraine.

Source (3) provides instructions on using the Google Classroom program, setting up an account, recruiting students/interns to a group, and assigning homework. It is also very convenient to hold an online meeting, it is possible to turn off the sound and video that will be broadcast to save traffic or if necessary.

There are several forms of online communication between the teacher and the student, namely: video conference, forum, chat, blog and questionnaire, and others. The main two forms that will be used in training are a conference and a forum. Detailed instructions on how to do this can be found in source (8). Video conferencing is mainly used for practical classes, where the teacher demonstrates certain practical material that the students/trainees need to learn.

Practical material can be combined with theoretical and displayed at the same time for a better mastering of a large array of data that can be voiced.

Conclusions at the end of the literary analysis.

Based on the materials of this section, the following conclusions can be drawn:

- To prepare an online class, a comprehensive approach is needed, which will include the selection of software, devices, and the venue for agreeing on the curriculum.
- The use of devices for working with specific characteristics to ensure the quality of delivery of educational and practical material is substantiated.
- An analysis of research on the topics of choosing high-quality video-to-audio recording devices based on laboratory testing was carried out.
- The workplace of the head of the educational process was developed, the literature was reviewed and the best recommended option was selected, as well as others that could be used under certain, possible working conditions were considered.
- Forms of conducting online classes and their features are considered.

CHAPTER 2

STUDY OF ONLINE LEARNING PLATFORMS AND SOFTWARE PACKAGES

2.1 Consideration of software packages

A software package is a set of programs that are fully compatible with each other. Program packages allow you to create a favorable environment for work or study. After all, you do not need to download the necessary programs separately, you can simply download a package that will contain everything you need.

The most popular of these are office packages. And among the office packages - the Microsoft Office package. It is in this program package that you can create, edit and move files between programs without difficulty. Such a solution greatly simplifies the work and reduces the load on both the student and the teacher.

A similar program package for training is the National Instruments - Multisim program package, or Autodesk, the first package allows you to design electronic and electrical circuits of various systems, simulate the work processes of a special device, or build it component-wise. Autodesk is a package of programs for drawing, sketches and drawings, reproducing schemes of objects in 2D or 3D.

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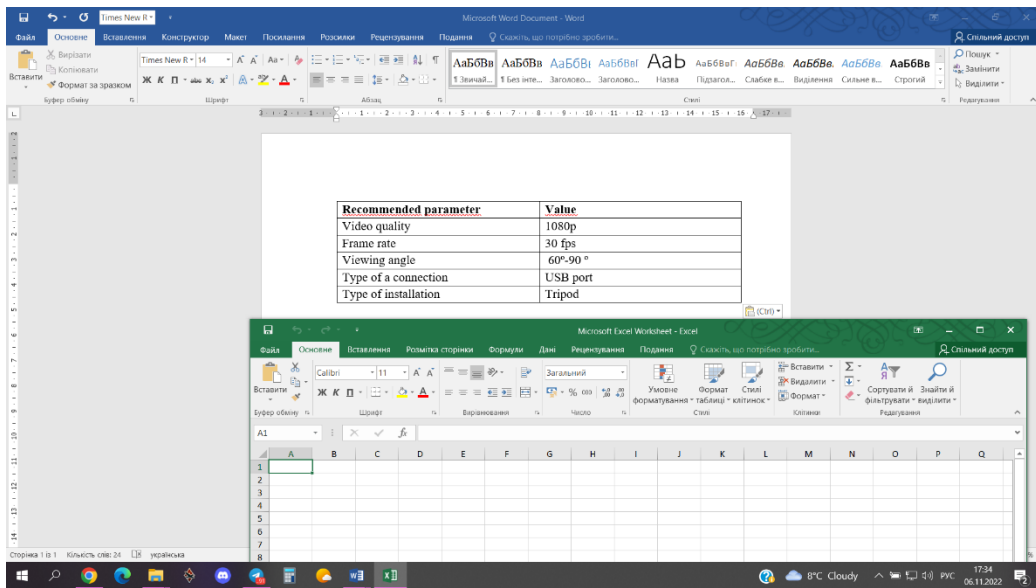


Fig 2.1 Screenshot of Microsoft Office

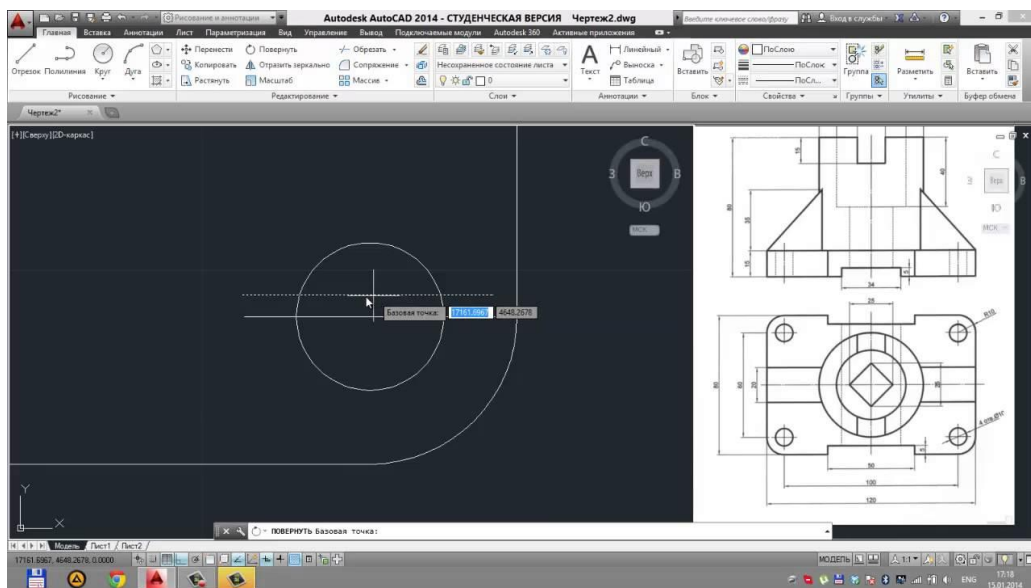


Fig 2.2 Screenshot of AutoCAD 2014

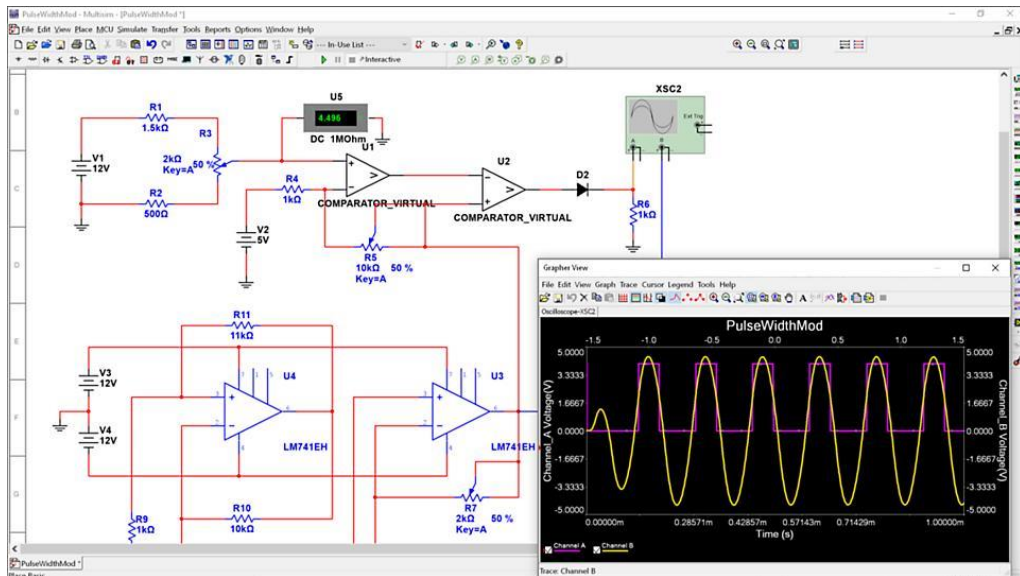


Fig. 2.3 Screenshot of Multisim

2.2 Consideration of platforms for distance learning

One of the most vivid examples of software platforms can be Google Classroom. It is a platform for online training, conducting video meetings, transferring any type of files, submitting educational material, testing, etc. Its advantage over other similar platforms for learning is the ability to run through a browser, which allows you to quickly and easily switch between different programs, using them simultaneously. This method greatly simplifies and speeds up the work, makes the beginning less tiring and more effective.

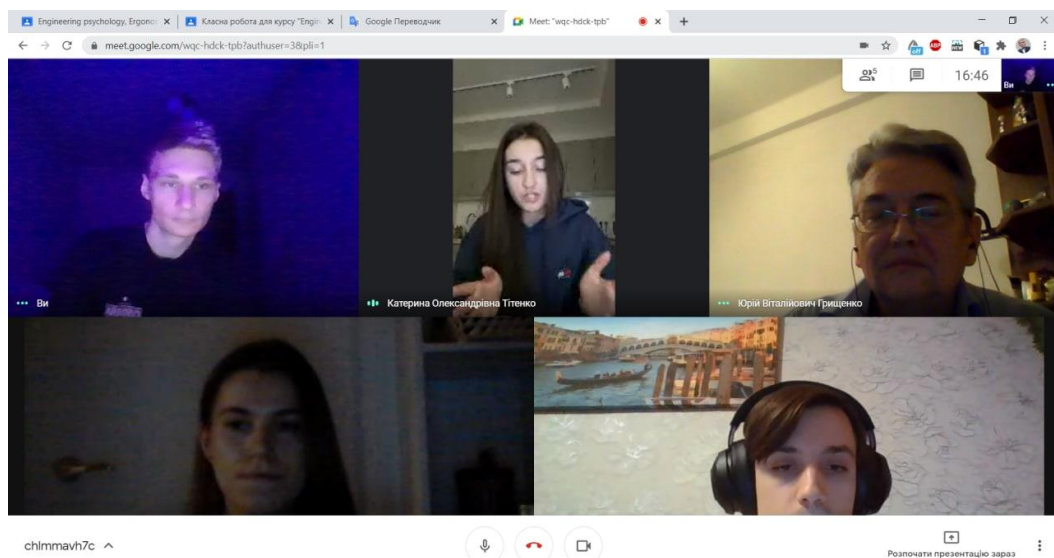


Fig. 2.4 Screenshot of Google Classroom

Platform tools: whiteboard, the ability to visually present the material, chat, the "raise your hand" function, chat, as well as muting and video functions; the ability to connect to Google Classroom for convenient and quick distribution of information, materials, tasks to each employee or individually.

There is also a functionally similar platform for holding online conferences - Microsoft Teams. Its only drawback is that it is not as popular as Google Classroom, although it is also built into the browser and can be used on any operating system.

Platform tools: virtual whiteboard, the ability to visualize the material, chat, the "raise your hand" function, a chat group in which you can correspond, and not during the meetings. Microsoft Teams is part of the Office 365 suite and is distributed through a corporate subscription that a company can purchase for its internal needs for a period of one year or more.

Conclusion

In this section, examples of platforms and software packages that can be used for online education were considered. Thanks to their functions and capabilities, they simplify and increase the effectiveness of the distance learning process.

CHAPTER 3

JUSTIFICATION OF CHOICE OF LEARNING HARDWARE AND SOFTWARE

3.1 Analysis and selection of hardware and software for conducting classes with aviation personnel on-line

Having chosen the program in which we will conduct video calls, we should choose the equipment for online classes and meetings. We need to choose a video camera, a microphone and, depending on the needs of the company, choose an audio output device, these can be both headphones and speakers if the meetings are held for a group of people. In order for the picture of the video stream to look beautiful and clear, and the sound to be without interference and of high quality, we need to select non-built-in audio and video input devices, since the available devices in the laptop do not. Does not satisfy us in terms of quality. To do this, we need to be guided by several important factors:

- 1) Product quality;
- 2) Low cost;
- 3) Reliability, durability of work;
- 4) Ease of use.

First of all, we need to have a device with which we will conduct our online classes - a PC. It has so many features, but some of them are really important:

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Table 3.1 Specification of PC

Recommended parameter	Value
PC type	Nettop Vinga
Processor series	Intel Celeron J4105
Video card model	UHD Graphics 600
The amount of installed memory	4 GB
Types of internal storage	SSD 64 GB
Wired network (LAN)	10-100 Mbit / s

The most suitable and reliable PC for our needs is the Vinga Mini PC V500. The second and very important device is the display, its characteristics:

Table 3.2 Characteristics of monitor

Recommended parameter	Value
Display diagonal	23.8 "
Refresh rate	75 Hz
Maximum display resolution	1920 x 1080
Matrix response time	5 ms
Display brightness	200 K / m ²
Matrix type	TN
Aspect ratio	16: 9
Connector	HDMI cable

The right monitor in terms of performance and price and quality 23.8" Samsung F24T350FHI Dark Gray.



Fig. 3.1 Image of monitor



Fig. 3.2 Image of PC block

Before choosing a webcam, it is important to know several basic criteria for its selection. To make the best choice from a wide range of cameras, take a look at the specifications.

It is best to have an external USB webcam. It can be placed both on a tripod and on a table with a special leg or on a computer monitor.

The camera should have a high image resolution, from 1080p to 4K. Resolution determines the quality of images. Standard 720p isn't a bad performance anymore. But anything less on the record will give you a very blurry image.

More frames per second. If you go to a budget camera with 7-10 frames per second, you will get a jerky image. 30 frames per second is enough for classes. Since for the human eye, the perception of a smooth picture began with a frequency of 20-25 frames per second. Good autofocus, so that regardless of your movements, the position of the head or body, the image is clear. Viewing angle from 60 to 90 degrees.

Table 3.3 Characteristics of camera

Recommended parameter	Value
Video quality	1080p
Frame rate	30 fps
Viewing angle	60°-90 °
Type of a connection	USB port
Type of installation	Tripod

A good and budget example of a camera that is mounted on a computer monitor could be the Defender G-lens 2597 HD720p. The same or similar camera by characteristics can be used in online classes.



Fig. 3.3 Image of camera



Fig. 3.4 Image of micro

After choosing a camera, we move on to choosing a microphone, here the task is a little more complicated. The microphone can be located as a separate device on a table, tripod, trains, attached to a monitor or wall nearby, or built-in, for example, into headphones, a previously selected camera, or into the laptop itself. It is also desirable that the microphone be with a USB connector.

With an operating frequency range of 20–20,000 Hz and a sensitivity of 6–10 dB. A special noise reduction function and manual selection of microphone sensitivity will also have a positive effect, for example, if the office is very noisy or the window is open

Table 3.4 Characteristics of micro

Recommended parameter	Value
Operating frequency range	20-20000 Hz
Sensitivity	6-10 dB
Type of a connection	USB port
Tupe of installation	Tripod

SPEEDLINK Capo USB Desk and Hand Microphone Black (SL-800002-BK) can be a good budget and a multi-functional microphone for both desktop and handheld use.

After selecting the microphone, we proceed to the selection of the sound output device, it can be both headphones with a microphone and speakers. Headphones are only useful if the session is held in a noisy room, so that each member of staff hears only the information that is intended for him, in addition, it helps to save on the purchase of a microphone, since it can be built into the headphones and brought to the mouth. Contrary to what they say will be needed when meetings are held for a large number of people, in a large room.



Fig. 3.5 Image of headphones Fig. 3.6 Image of speakers

Headphones must have a 3.5 mm plug equipped with a cable of sufficient length, preferably about 1 meter. With an operating frequency range of 20–20,000 Hz and a sensitivity of 6–10 dB. On the one hand, you should install a

special bracket in which the microphone will be located, which during a conversation can be conveniently brought into the mouth or moved away so that it does not interfere.

Table 3.5 Characteristics of headphones

Recommended parameter	Value
Plug size	3.5 mm
Sensitivity	6-10 dB
Operating frequency range	20-20000 Hz
Wire length	1m
Other functions	Micro is installed

SVEN AP-525MV is a great budget option of headphones with an adjustable microphone, with a long cable and a volume control for full convenience during work.

After choosing headphones, we move on to choosing speakers, we will consider them only for the situation when lectures will be held for a large audience. A single pair of speakers can save a company money, as many pairs of headphones are much more expensive. On the contrary, speakers will be needed when meetings are held for a large number of people in a large room.

The speakers must have a 3.5 mm plug, be equipped with a long enough wire, preferably about 1 m, and a manual volume control. And with a total power of at least 5 W. The Kisonli K100 is a good, inexpensive speaker option that can be replaced with variable volume, with a long cable for ease of use.

Table 3.6 Characteristics of speakers

Recommended parameter	Value
Plug size	3.5 mm
Power source	220 V or USB 2.0
Power	5 W
Operating frequency range	20-20000 Hz

To conduct a practical lesson on an airplane, you need a mobile camera that will shoot the subject of research, you need a tripod on which you can install a phone that broadcasts a picture for listeners. The ability to rotate, tilt and fix the phone to capture a specific area inside the aircraft makes this device very convenient, with skillful use it can replace the operator.

Also, in order to ensure that the sound quality is not reflected at a distance, it is recommended to use wireless headphones with a built-in microphone. This will allow you to hear the questions being asked well, and will also improve the sound quality if the lesson is held in the place where the work is being done. Therefore, JBL TUNE 125BT is recommended.



Fig 3.7 Tripod for mobile phone



Fig 3.8 Wireless headphones

Table 3.7 Characteristics of tripod

Recommended parameter	Value
Height	1200 mm..
Folded height	350 mm.
Rotated axes	X, Y
Weight	420 g.

Table 3.8 Characteristics of wireless headphones

Recommended parameter	Value
Connection type	Bluetooth
Battery life	16 hours
Sensitivity	96 dB
Operating frequency range	20-20000 Hz

Depending on the location and method of connection, a video conference session may require different peripherals.

Consider video conferencing in a meeting room (congress hall).

In order to equip a meeting room with quality, it is necessary to observe many nuances. Naturally, the more they are, the higher the cost of education. First of all, it is necessary to correctly calculate and install the sound reinforcement system. If the hall is small, it will be enough to install one or more loudspeakers (these are special devices that combine one or more microphones and speakers and are designed to eliminate echo and noise).

Next, you will need a rotary video camera, it differs from the usual one in the ability to rotate, tilt up and down, as well as zoom in and out. Such a camera can switch between the faces of the speakers and the audience both in manual and automatic modes (special equipment is required for this). As a display system, it is recommended to use two large LCD screens: one for participants' videos, and the other for presentations and other content.



Fig. 3.9 Example of Video broadcast equipment (tracking camera)

Well, not the last place is occupied by the interior of the room: good lighting, a contrasting, but not bright background on the walls, noise-absorbing panels, and so on. As you can see, the cost of equipment for a meeting room, depending on the chosen video conferencing solution, peripheral equipment and decor, can differ by an order of magnitude.

There are already many ready-made kits and complexes that include everything you need, but take up extra space on the table. Therefore, often, including for the sake of the economy, a regular working PC is used as a video

conferencing terminal, since there is no difference in quality between it and specialized hardware systems with the right choice of peripherals.

A good example of a conference room for a 14-20 person room is the LOGITECH GROUP camera, which has a built-in microphone and a PTZ camera for a speaking person, and has excellent picture and sound performance

Table 3.9 Characteristics of multifunctional camera

Recommended parameter	Value
Maximum video quality	1920x1080 Full HD
Maximum frame rate	30 fps
Rose connection	USB
Fastening	Tabletop
Focusing	Auto
Coot look around	90 °
Length of cable	5 m
Frequency response	100 Hz - 11 kHz
Sensitivity	-28dB +/- 3dB
Distortion	<5% at 200Hz

3.2 Development of the workplace of an avionics specialist trainee

Since the training is carried out remotely, the student is either at home or in the office, or on a business trip, for example, in a lounge, hotel, etc. In this case, his workplace should be located at a table, in a room with a low noise level.

In the case of a lecture class, the teacher does not have to be on the plane and he can also read certain material from the premises, be it his home or work office. In this case, the workplace of the teacher and the student differs only in the

presence of an additional monitor and a camera for providing additional information. The workplace should be equipped with the following devices:

- 1) Computer, mouse, keyboard;
- 2) Monitor, which will broadcast information during the lesson;
- 3) The second monitor for the prompt and showing the general picture, which is broadcast during the lesson;
- 4) Camera filming the lesson leader;
- 5) A camera that captures information on a board, or shown by a projector;
- 6) A camera that captures the working surface of the table, on which the tutor can make notes, drawings, or clearly show something;
- 7) Microphone, speakers or headphones.

Table 3.10 Characteristics of the workplace

Recommended parameter	Value
Monitor type	Not less than IPS
Brightness of monitors	400 K / m ²
Noise level in room	15-20 dB
Illumination of the room	500 L
Table dimensions	140x60 cm
Working surface height	75 cm
Chair seat height	45 cm
Chair seat width	45 cm
Distance between eyes and monitor	65 cm
Chair back height	100 cm

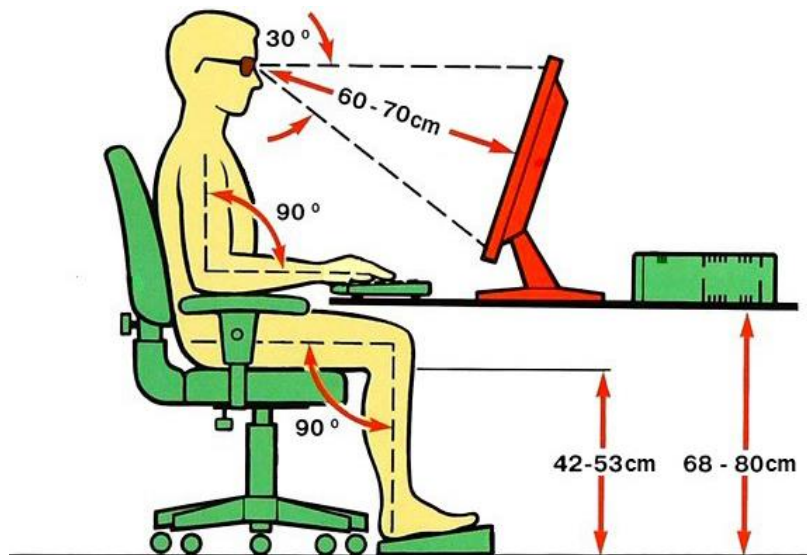


Fig. 3.10 Dimensions of the workplace

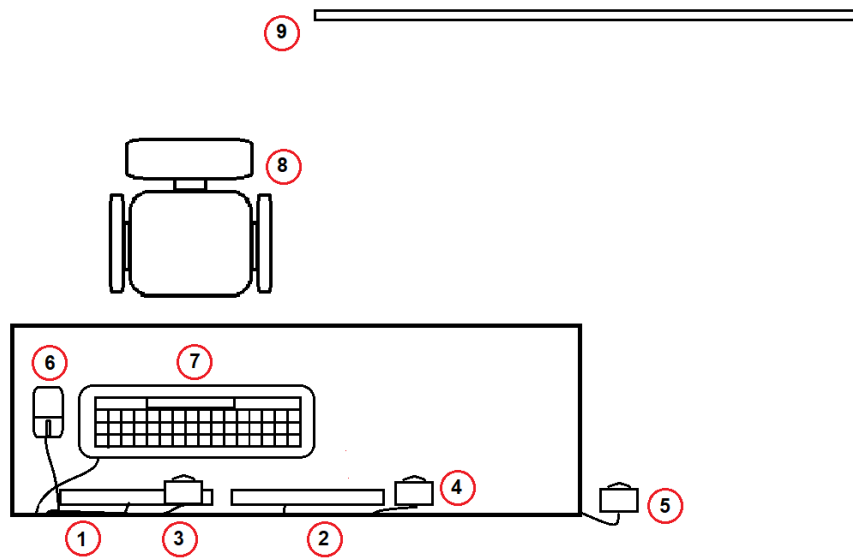


Fig. 3.11 General scheme of the workplace

1,2 - Monitors, 3 - Camera, which is directed at the lesson leader, 4 - Camera, which is directed to the workplace, installed vertically, 5 - Camera, which films the board, 6 - Mouse, 7 - Keyboard, 8 - Chair, 9 - Board.

3.3 Development of the workplace of a specialist - teacher

Since the practical sessions will be conducted on an airplane, a workplace for the teacher has been designed. The figure shows a diagram of the longitudinal section of the An-26 cockpit and the location of the tools for conducting the lesson.

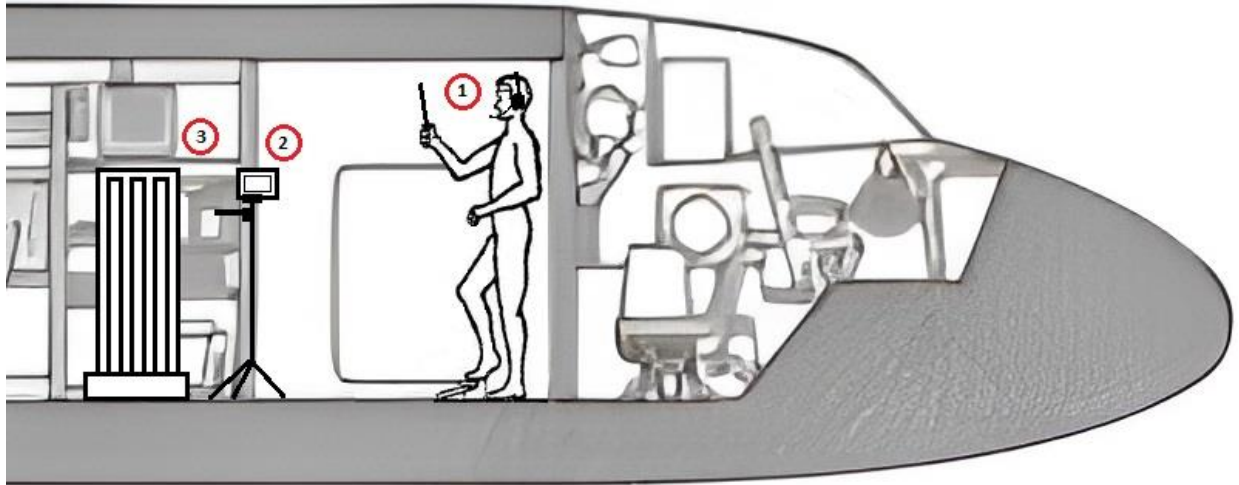


Fig. 3.12 Scheme of equipment for a practical lesson

1 - Wireless headphones with microphone, 2 – Mobile phone mounted on a tripod, 3 - Lighting installation.

Conclusion

In this section, we have carefully reviewed software tools for training, selected equipment for conducting online classes, and formulated requirements for parameters and conditions at the workplace as a trainee - an avionics specialist, as well as a teacher. The possibility of arranging the teacher's workplace on an airplane to carry out practical tasks was also considered.

CHAPTER 4

DEVELOPMENT OF THE METHODOLOGY FOR CONDUCTING THE TRAINING PROCESS WITH AIRLINE PERSONNEL

4.1 Development of a methodology for conducting a lecture class

The basis of conducting a lecture class is a concise and clear presentation of theoretical material to the audience. The lecture is the main form of the educational process.

The purpose of the lecture is to reveal the main provisions of the topic, to find out unsolved problems, to summarize the work experience, to give recommendations on the use of the received information and to draw conclusions.

But first of all, you need to choose the literature, which will be used.

Information that can be presented as educational material can be found in:

- Manuals;
- Maintenance instructions;
- Schematic brochure;
- Video manuals;
- Technical descriptions;
- Training stands.

The style or method of presenting information may differ depending on the country, the teacher's professionalism, and the requirements of the curriculum.

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<i>Виконав</i>	<i>Коновал В.П.</i>			Application of hardware and software tools for training airline technical staff in avionics	<i>Лім.</i>	<i>Арк.</i>	<i>Акрушів</i>
<i>Керівник</i>	<i>Белінський В.М.</i>					<i>35</i>	<i>94</i>
<i>Консульт.</i>	<i>Белінський В.М.</i>				173 «Авіоніка»		
<i>Н-контр.</i>	<i>Левківський В.В.</i>						
<i>Зав. каф.</i>	<i>Грищенко Ю.В.</i>						

It`s mainly divided into:

- 1) Lecture (presentation) - a useful form of teaching, which is used in real theatrical, methodological knowledge. Learn to apply the information gained in practice. In this process, doctors and managers and qualified specialists enterprise or mimo lecturers.
- 2) Seminar, conference - an energetic form of training, the topic is usually known in the warning. Listeners exchange opinions, ask questions, challenge each other. The trainer will moderate the meeting. A seminar is usually held after a lecture to consolidate material covered. Participation in seminars develops logical thinking and produces ways of being in different situations.
- 3) Coaching is an energetic form of learning, a number of which is the development of certain skills in the employee. In a number of ways, just like the seminar, and in addition to theory, there is more practice - participants in the study, using knowledge gained. Workouts are mainly used for workouts.
- 4) Independent work is individual, independent form of learning. This can be extracted from the worker himself, it can be carried anywhere with access to materials, manuals, video lessons.
- 5) Blended learning - learning that combines several types discussed above. For example, you can check for the first time that the theory online will be the reading material at any place convenient for the worker. After the face-to-face meeting, the coach does no waste time on methodology and focuses on practice.

4.2 Development of practical training methods

A practical class is a type of class during which a scientific and pedagogical worker organizes the assimilation of theoretical knowledge from the academic discipline by cadets (students, students) by performing specially formulated tasks

and promotes the formation of their skills and abilities in the practical application of this theoretical knowledge.

The method of practical training is somewhat simpler. Its essence is to visually show information to the student and enable the assimilation of this material through interaction, use or processing of this information.

Also, practical training can be in the form of training - independent application of the skills and knowledge acquired by the student, demonstration of skills and ability to cope with non-linear tasks on one's own, adapt to the surrounding conditions and find solutions to somewhat complicated problems - self-practice.

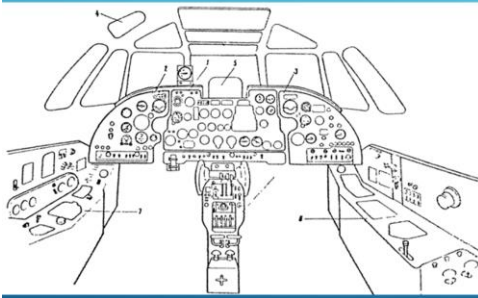
I developed and tested a practical lesson on the topic of An-26 aircraft cabin equipment. Additional material for familiarization was created in the form of a Microsoft PowerPoint presentation. The practical lesson is devoted to internal aeronautical equipment, its placement, appearance, functionality and basic structure.

The test lesson was conducted online, on board the aircraft, using the appropriate equipment, with sufficient lighting, corrected mistakes and incompleteness of the lesson plan and technical malfunctions, all internal elements and complexes of the aircraft cabin were demonstrated.

4.3 Making slides for practice presentation



SCHEME OF PILOT'S FLIGHT-CONTROL AND NAVIGATION EQUIPMENT IN CREW CABIN



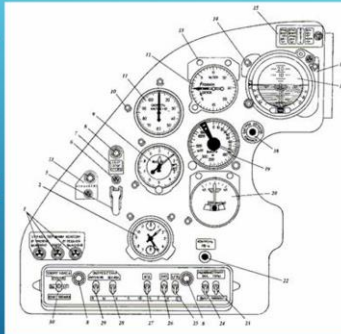
1 – installation of middle pilots' instrument panel, 2 - installation of glare shield and IV-41 indicator, 3 - pilots' central control pedestal layout, 4 - vibration instruments installation, 5 - pilot's radar scope and KI-13 compass installation, 6 - an-26 airplane check list, 7 - pilot's left control console installation, 8 - pilot's right control console installation.

PILOT'S CONTROL PANELS

- ▶ Structurally, the dashboard consists of three unrelated flat panels: left (LGD), middle (MGD) and right (RGD). Each panel is attached to the structural elements through standard shock absorbers. A visor is installed above the dashboard, which serves to protect the instrument scales mounted on the board from solar glare.
- ▶ The front sides of the panels and the visor are covered with black paint. To facilitate the installation and dismantling of devices, the middle panel is designed to fold down by turning around its lower edge. The right and left panels are made easily removable.
- ▶ For ease of review and use, switches for instruments, units, systems and other equipment on the left and right panels are mounted on separate shields, which are bent towards the pilots. A panel with switches is installed under the middle panel of the dashboard, which is attached obliquely to the panel.
- ▶ On the visor are installed: AUASP pointer - above the middle panel of the dashboard, on the left and signal board blocks - above the left and right panels of the dashboard. Above the canopy on the cockpit canopy, there is a radar indicator, indicators of the IV-41BM onboard vibration-converting equipment, position indicators for the output shaft IM-24 of the PRT-24 temperature limiting system, and a KI-13 magnetic compass.

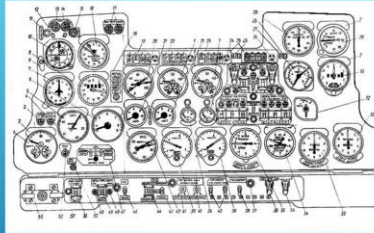
THE LEFT GADGETS PANEL OF PILOTS (LGD)

1 - signal lamp "Front wheel control" from the handle, from the pedals; 2 - hours; 5 - switch "Emergency cargo drop"; 6 - signal lamp "Emergency dumping of cargo"; 7 - stencil; 8 - backlight fittings; 9 - altimeter; 10 - red light lamp; 11 - combined speed indicator; 12 - variometer VAR-30MK; 13, 14, 16 - red lamps; 15 - signal board ("Danger of vibration of the left engine", "Danger of vibration of the right engine", "Altitude", "Attention, locator"); 17 - AGD-1 attitude indicator; 18 - button "Quick compass alignment"; 19 - radio altimeter indicator RV-4; 20 - electric direction indicator; 21 - signal lamp "Failure 6201"; 22 - button "Control RV-4"; 23 - radio altimeter switch "Mountains-Plain"; 24 - switch "Radio altimeter"; 25 - switch "TsGV"; 26 - switch "EUP"; 27 - switch "AGD"; 28 - switch "Glass heating reduced"; 29 - switch "Glass heating intensive"; 30 - switch for controlling the rotation of the wheel.



Middle gadgets panel of pilots (MGD)

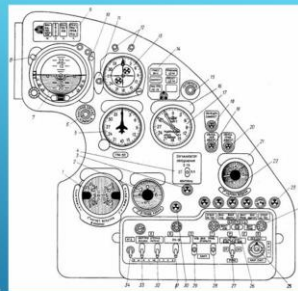
1 - three-pointer motor indicators; 2, 9, 12, 31 - red lamps; 3 - signal lamp "Work of PT-29"; 4 - signal lamp "Tape is open"; 5 - tachometer indicator; 6 - APU exhaust gas temperature gauge; 7 - course setter; 8 - direct-reading device of range and azimuth; 10 - combined flight and landing instrument; 11 - "Ready" button; 13 - signal lamp "Target Approach"; 14 - signal lamp "Span of the target"; 15 - signal lamp "Marker"; 16 - ARC-11 radio compass pointer; 17 - signal lamps "The screw is removed from the stop"; 18 - signal board ("Operating KV-SV TX", "Long range failure", "Azimuth failure", "Gliss. on"); 19 - alarm board ("Doors, hatches open", "Oxygen", "Right engine failure", "Left engine failure"); 20 - position indicators of the levers of the engine fuel units; 21 - exhaust gas temperature indicators; 22 - signal board ("Failure of the HE left", "Failure of the GO right", "Failure of STG left", "Failure of STG right"); 23 - signal board ("Emergency power supply 27 V", "Min. remaining oil left", "Min. remaining oil right", "Fuel 680 kg"); 24 - torque gauge indicator; 25 - signal board ("Fuel pressure, left engine", "Left filter failure", "Right filter failure", "Fuel pressure, right engine"); 26 - fuel shield with switches and signal lamps; 27 - fuel gauge indicator; 28 - combined speed indicator; 29 - variometer;



30 - UVID 30-15 altimeter; 32 - fuel gauge switch; 33 - air flow indicator; 34 - indicator altitude and differential pressure; 35 - variometer; 36 - switch "emergency pressure release"; 37 - low backlight fittings; 38 - "flowmeter" switch; 39 - fuel consumption indicators; 40 - fuel gauge switches; 41 - switches "oil cooler damper control"; 42 - engine tachometer meter; 43 - switch "headlights released-retracted"; 44 - switch "headlights big light-small light"; 45 - signal board "chips in engine, A ion. (Rights)"; 46 - switch "ANO"; 47 - flight and landing device; 48 - signal lamps "automatic wheel braking"; 49 - switch "automatic wheel braking"; 50 - signal lamp for emergency activation of the pumping station; 51 - switch "emergency pumping station"; 52 - signal lamp "TCA failure"; 53 - trimmer emergency control panel; 54 - switch "disabling the blocking of the landing gear";

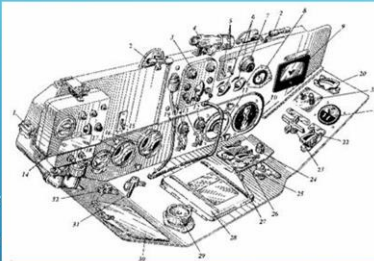
RIGHT GADGETS PANEL OF PILOTS (RGD)

1 - temperature indicator of the air injected into the cab (from the set ZIUE-111); 2 - air temperature gauge in the cargo compartment (from the TV-19 kit); 3 - signal lamp for aircraft icing alarm control; 4 - aircraft icing alarm switch; 5 - course setter; 6 - button "Quick compass matching"; 7 - indicator of the artificial horizon (from the AGD-1 set); 8, 10, 11, 12, 16, 21 - red lamps; 9 - signal board ("Attention locator", "Height", "Failure PVD-7 left", "Failure PVD-7 right, PPD-1"); 13 - combined flight and landing instrument; 14 - signal board ("Gliss. on", "Marker", "KV-SV TX is working", "Approximate target", "Target flight"); 15 - "Ready" button; 17 - ARK-11 radio compass pointer; 18 - signal lamps "Aircraft icing"; 19 - "Icing of the left engine"; 20 - "Icing of the right engine"; 22 - outdoor air temperature indicator (from the INV-15 kit); 23 - signal lamps of the heating system of individual units; 24 - backlight fittings low; 25 - propeller heating switch from the main and emergency systems; 26 - heating control switch for the left and right propellers; 27 - switch "Wing and plumage, input RU19-300, automatic, - off, - manual"; 28, 29 - VVA heating switches; 30 - signal lamp "Heating RU19-300"; 31 - additional engine heating switch; 32 - switch "Glass heating intensive"; 33 - switch "Glass heating is weakened"; 34 - "AGD" switch.



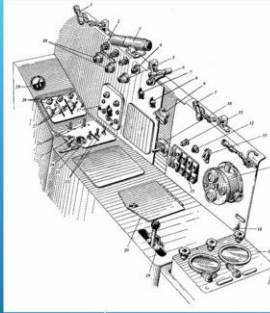
LEFT CONTROL CONSOLE SCHEME

1 - oxygen valve; 2 - lamps of red light; 3 - subscriber unit; 4 - red light lamp; 5 - pilots' dashboard lighting switches; 6 - transformers for lighting with red light of the middle and left panels of the pilots' dashboard; 7 - red light rheostat of the left side of the cockpit; 8 - current control ammeter at startup; 9 - voltage control voltmeter when starting engines; 10 - oil gauge pointer; 11 - indicator of the amount of slurry; 12 - signal lamp for the open position of the air intake flap of the APU; 13 - APU air intake flap control switch; 14 - radiometer console; 15 - clock heating switch; 16 - gauge pointer 2DIM-150 "Brake pressure"; 17 - gauge indicator 2DIM-240 "Pressure in the main system" and "Pressure in the hydraulic accumulator"; 18 - pointer of the pressure gauge DIM-240 "Pressure in the emergency system"; 19 - APU fire hydrant control switch; 20 - emergency opening emergency hatch switch; 21 - pressure gauge - indicator; 22 - emergency shutdown switch for autopilot seating gears; 23 - valve for switching on emergency pressure in the main hydraulic system; 24 - signal lamp "Emergency reset of suspensions from the DB"; 25 - tap for switching on the wiper; 26 - "Explosion-Non-explosion"; 27 - "Reset-Off."; 28 - a shield for starting the main engines and an additional engine; 29 - the handle for turning the front wheel; 30 - hatch for a bag with an oxygen mask; 31 - valve for supplying devices from the full pressure system; 32 - power supply valve for devices from the static pressure system; AUASP check box.



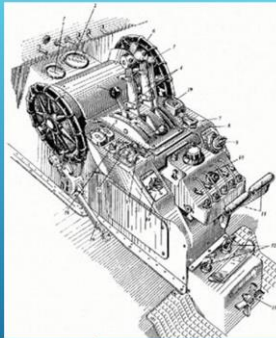
THE RIGHT CONTROL CONSOLE SCHEME

1, 3 - lamps of red light; 2 - fuses for lighting control panels and PPPD pilots; 4 - button "Turn on the siren"; 5 - rheostat for lighting the starboard side of the aircraft with red light; 6 - button "Intermittent alarm control"; 7, 8 - transformers for lighting with red light for PPPD and control panels; 9 - oxygen valve; 10 - power supply valve for devices from the static pressure system; 11 - signal lamp of LMP operation of MSRP-12 recorder; 12 - button for checking the LMP of the MSRP-12 recorder; 13 - oxygen device; 14 - switch for lighting the front landing gear; 15 - remote control signal rockets; 17 - subscriber unit; 18 - command device ARD; 19 - emergency hatch control valve; 20 - hatch for a bag with an oxygen mask; 22 - switches for manual temperature control in the cabins of the right and left systems; 23 - switch "Automatic. - manual" temperature control in the cabins; 24 - switch of the temperature controller; 25 - wiper tap; 26 - switches for controlling the air supply to the cabins; 27 - heating switches for receivers PVD-7 and PPD-1; 28 - signal lamps for the health of the heating of the receivers PVD-7 and PPD-1; 29 - pressure gauge - indicator; 30 - rheostats for adjusting the brightness of combat lights; 31 - "MSRP control" switch.



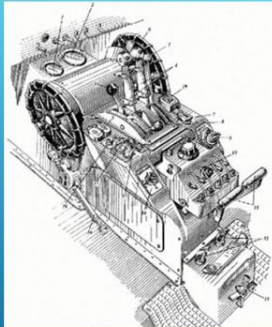
MIDDLE CONTROL CONSOLE SCHEME

1 - indicator of the position of the flaps; 2 - indicator of the position of the oil cooler flaps; 3 - APU control lever; 4 - engine control levers; 5 - engine stop switches; 6 - steering wheels for controlling the trimmers of the elevator; 7 - switch for emergency release of flaps; 8 - lever for shifting stops of in-flight idle gas; 9 - switch for releasing and retracting the landing gear; 10 - autopilot control panel; 11 - emergency braking levers; 12 - handles for hydraulic propeller feathering and engine shutdown; 13 - drain valve of the chassis release system; 14 - switch for cleaning and releasing flaps; 15 - rudder trim control switch; 16 - steering wheel locking handle; 17 - aileron trim control switch; 18 - signal lamps of the disabled position of the rudder and aileron trimmers; 19 - switch for removing screws from the stop; 20 - braking handle of engine control levers; 21 - signal lamps for the neutral position of the rudder and aileron trimmers.



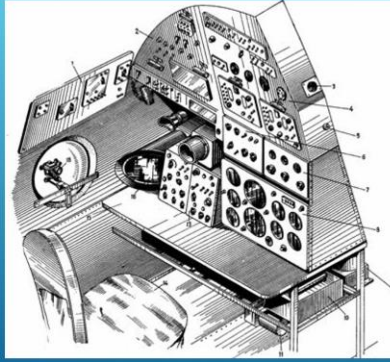
MIDDLE CONTROL CONSOLE SCHEME

1 - indicator of the position of the flaps; 2 - indicator of the position of the oil cooler flaps; 3 - APU control lever; 4 - engine control levers; 5 - engine stop switches; 6 - steering wheels for controlling the trimmers of the elevator; 7 - switch for emergency release of flaps; 8 - lever for shifting stops of in-flight idle gas; 9 - switch for releasing and retracting the landing gear; 10 - autopilot control panel; 11 - emergency braking levers; 12 - handles for hydraulic propeller feathering and engine shutdown; 13 - drain valve of the chassis release system; 14 - switch for cleaning and releasing flaps; 15 - rudder trim control switch; 16 - steering wheel locking handle; 17 - aileron trim control switch; 18 - signal lamps of the disabled position of the rudder and aileron trimmers; 19 - switch for removing screws from the stop; 20 - braking handle of engine control levers; 21 - signal lamps for the neutral position of the rudder and aileron trimmers.



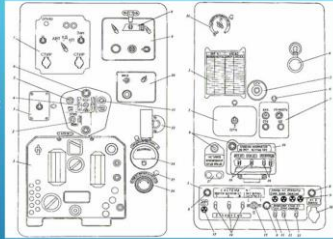
NAVIGATOR'S WORKPLACE SCHEME

1 - panel with control panels for radio equipment; 2 - reset shield; 3 - pressure gauge-indicator IK-18 flight engineer; 4 - top shield; 5 - SPU button; 6 - control panel for the RSBN-2S system; 7 - control unit SRP RSBN-2S; 8 - dashboard; 9 - gyro unit G-3M; 10 - remote block DP-3B; 11 - corrective mechanism of KM; 13 - block 2NV-4Sh of the radar station RPSN-3N; 14 - armchair; 15 - table; 16 - gyro-semicomputer GPK-52AP; 18 - sight NKPБ-7s.



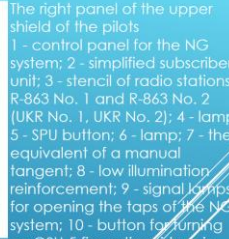
SIDE PANELS IN UPPER SHIELD

The left panel of the upper shield of the pilots
 1 - control panel for the ARK-11 radio compass; 2 - transponder switch; 3 - button "Explosion" of the transponder; 4 - switch "SP-50 RSBN-2S"; 5 - signal light; 6 - low illumination reinforcement; 7 - transponder control panel; 8 - lamp; 9 - control panel of the RSBN-2S station; 10 - control panel for the SP-50 system; 11 - button "Identification" station RSBN-2S; 12 - lamp; 13 - switch of the SP-50 system; 14 - setting indicator; 15 - lamp; 16 - shield illumination rheostat.



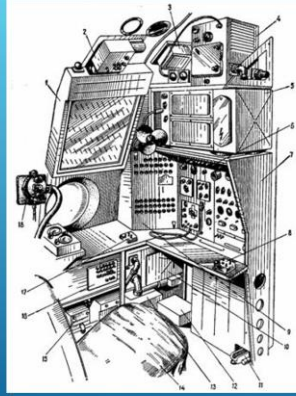
12 - switch of taps of the NG system "Phase II"; 13 - switch for switching on NG cylinders; 14 - switches for turning on NG cylinders; 15 - signal lamp "LP pressure"; 16 - rheostat-transformer; 17 - buttons for partial feathering of engine propellers; 18 - switches for checking the autovane; 19 - shield for checking the autovane;

The right panel of the upper shield of the pilots
 1 - control panel for the NG system; 2 - simplified subscriber unit; 3 - stencil of radio stations R-863 No. 1 and R-863 No. 2 (UKR No. 1, UKR No. 2); 4 - lamp; 5 - SPU button; 6 - lamp; 7 - the equivalent of a manual tangent; 8 - low illumination reinforcement; 9 - signal lamps for opening the taps of the NG system; 10 - button for turning on OSU-5 fire extinguishers in the fire fighting system; 11 - switches of the cranes of the NG system "stage - Lowering";



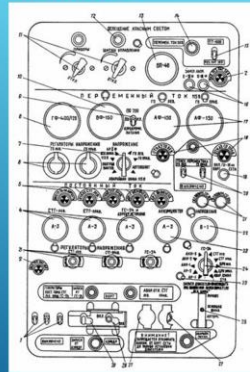
RADIO OPERATOR'S WORKPLACE (EARLY SERIES)

1 - Gas station shield; 2 - RK of DIM devices; 3 - box of antenna relays; 4 - SVB-5 transmitter; 5 - R-846 transmitter; 6 - panel with shields of radio equipment; 7 - electrical panel; 8 - telegraph key; 9 - panel with 11 and 36 V AC fuses; 10 - radio receiver; 11 - foot tengenta; 12 -; transformer; 13 - power element of the CB transmitter; 14 - armchair; 15 - fuel gauge measurement unit; 16 - RK cockpit; 17 - control panel MS-61; 18 - oxygen device KP-24M.



RADIO OPERATOR'S ELECTRICAL PANEL

1 - switches of the GS-24 generator, left and right STG; 2 - signal lamps for switching on the backup power supply 36 V; 3 - remote resistance STG lev. ", "GS-24"; 4 - DC ammeters "STG lev. ", "STG is right. ", "GS-24 and aerodrome. source"; 5 - signal lamps "On. GS-24 to the onboard network", "AR-21 is on", "AR-2 is on", "STG failure lev. "; 6 - remote resistance of the left and right GO; 7 - voltage test switch; 8 - AC hertzmeter; 9 - switch for switching on the converter PO-750 and airfield power; 10 - AC voltmeter; 11 - red lighting transformers for instruments and shields; 12 - fuses for lighting with red light; 13 - voltmeter; 14 - low illumination reinforcement; 15 - switch for switching on the PT-1000 converter and backup power; 16 - buttons for measuring the voltage of I-III and II-III phases; 17 - AC ammeters; 18 - signal lamps for the failure of the operation of the left and right GO; 19 - button for turning on the GO-16 to the onboard network; 20 - switches for switching on alternating current generators; 21 - fuses of STG voltmeters of the left and right; 22 - DC voltmeter; 23 - battery ammeter; 24 - voltmeter switch; 25 - lamp; 26 - emergency power switch; 27 - button for emergency shutdown of excitation of the left and right STG generators; 28 - power switch "Airfield - Board"; 29 - turbogenerator switch.



Conclusion

In this section, examples of conducting various types of online classes with the use of modern equipment that improve efficiency and simplify the perception of educational failure material were considered. Methods of conducting lectures and practical classes on the plane were demonstrated.

CHAPTER 5

EXPERIMENT

5.1 Preparation for an online classes

Before teaching lessons, you need to properly prepare for classes. You should know about the educational level of listeners, their age and occupation, following from this, choose and prepare information, materials and teaching method for classes and meetings, this is written in Chapter 4, as well as have a connection in some kind of application with all these people and their phone numbers, for convenient communication outside the classroom. Draw up and agree on a schedule for future online lessons. Because not every member of the class can be free at a particular time of the day.

Next, equip your workplace, check and configure your computer and other gadgets, as shown in Chapter 3.

5.2 Instructions for launching and using the application for an online lesson

1) Open Google Chrome or your other browser and go to the Google Classroom page;

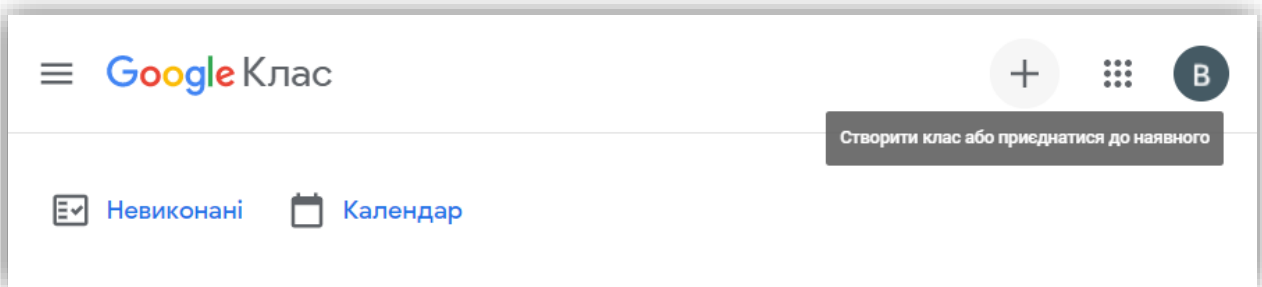


Fig. 5.1 Screenshot of Google Class

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<i>Керівник</i>	<i>Белінський В.М</i>					43	94
<i>Консульт.</i>	<i>Белінський В.М</i>				173 «Авіоніка»		
<i>Н-контр.</i>	<i>Левкієвський В.В</i>						
<i>Зав. каф.</i>	<i>Грищенко Ю.В.</i>						

2) You are on the main page environment page Google Classroom on the main page medium click top right button "+", Select "Create a class";

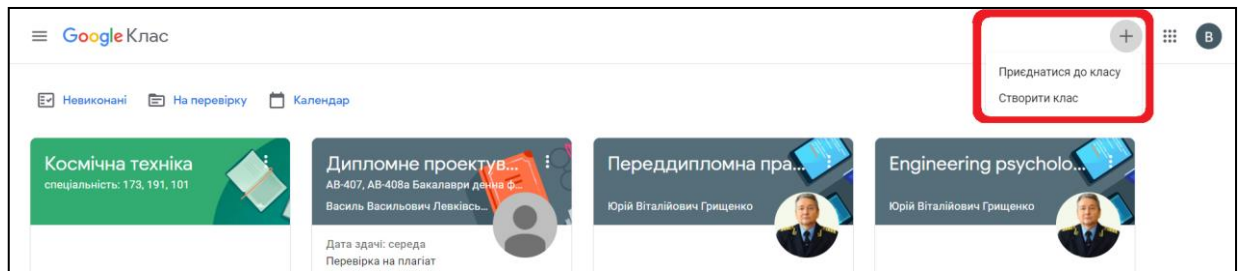


Fig. 5.2 Screenshot of adding new class

3) In the creation window virtual course / class enter its name and attributes (on own desire) and press the button "CREATE";

Деталі курсу

Назва класу (обов'язково) Кабіна екіпажу літака та її обладнання
Опис курсу
Розділ спеціальність: 173
Аудиторія

Fig.
5.3

Screenshot of class creation

Your course / class created !

4) Add to the course listeners through the menu People → Invite employees by sending your code course / class;

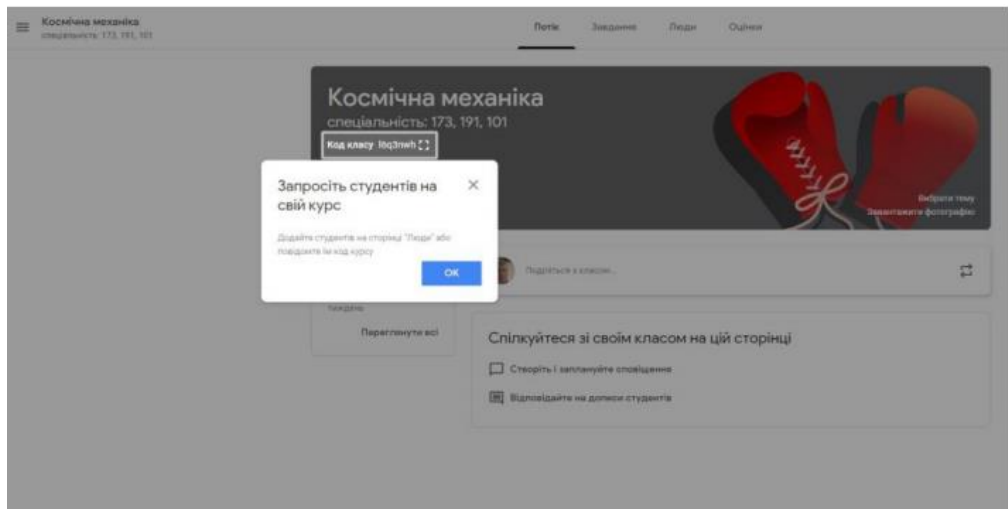


Fig. 5.4 Screenshot of listeners invitation

The group is dialed, wait confirmation and joining the course. In the absence address information electronic mailboxes listeners, you can send them an invitation code for the course others available ways.

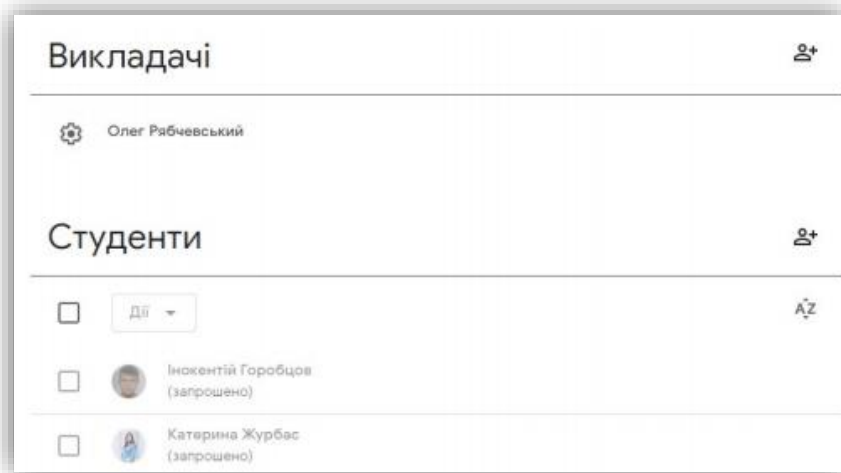


Fig. 5.5 Screenshot of class listeners list

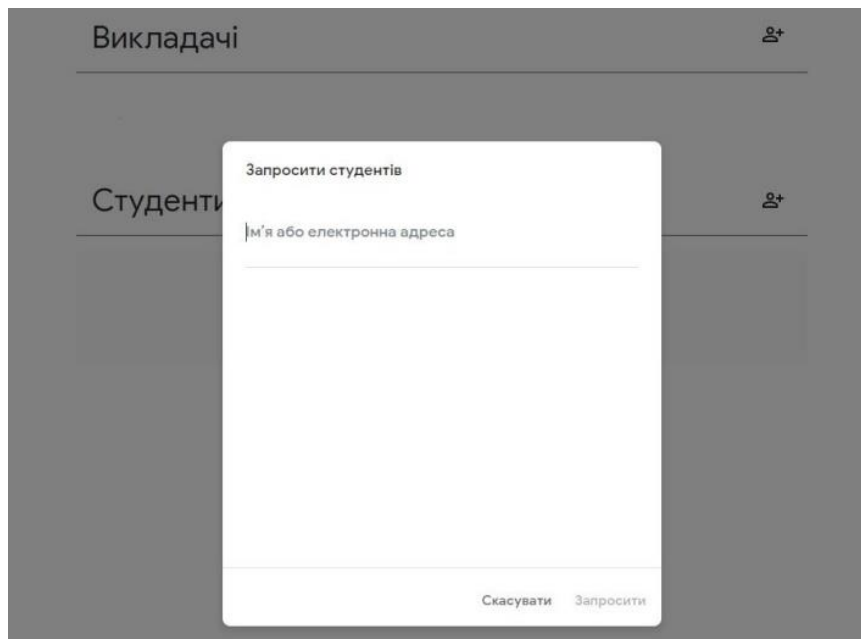


Fig. 5.6 Screenshot of sending the invitations

5) Click on the right at the top of the button with the gear on the page, which will open, in common settings near names "Class code" click on the right on the hidden field list, select one required commands;

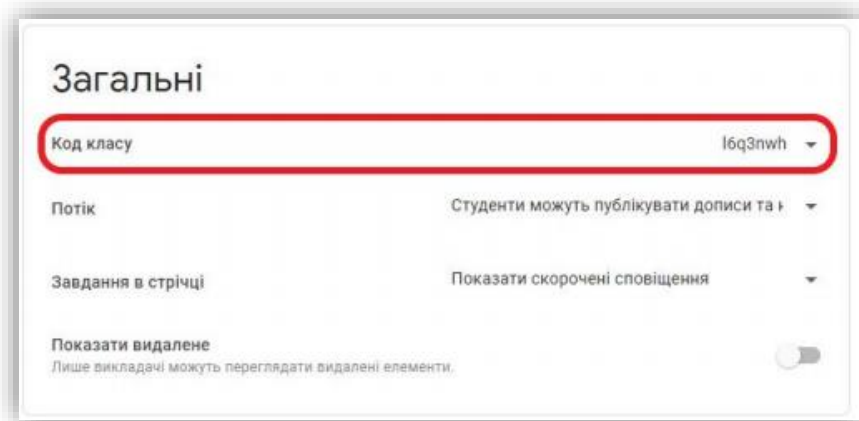


Fig. 5.7 Screenshot of Google Classroom code

6) After recruiting listeners to the group, send them an online task in the Tasks → + Create tab. Then enter the name of the topic of the task and, if necessary, add a file;

7) Having created the task and setting deadlines his surrender, go before admission and task evaluation. Click on the name tasks in the stream;

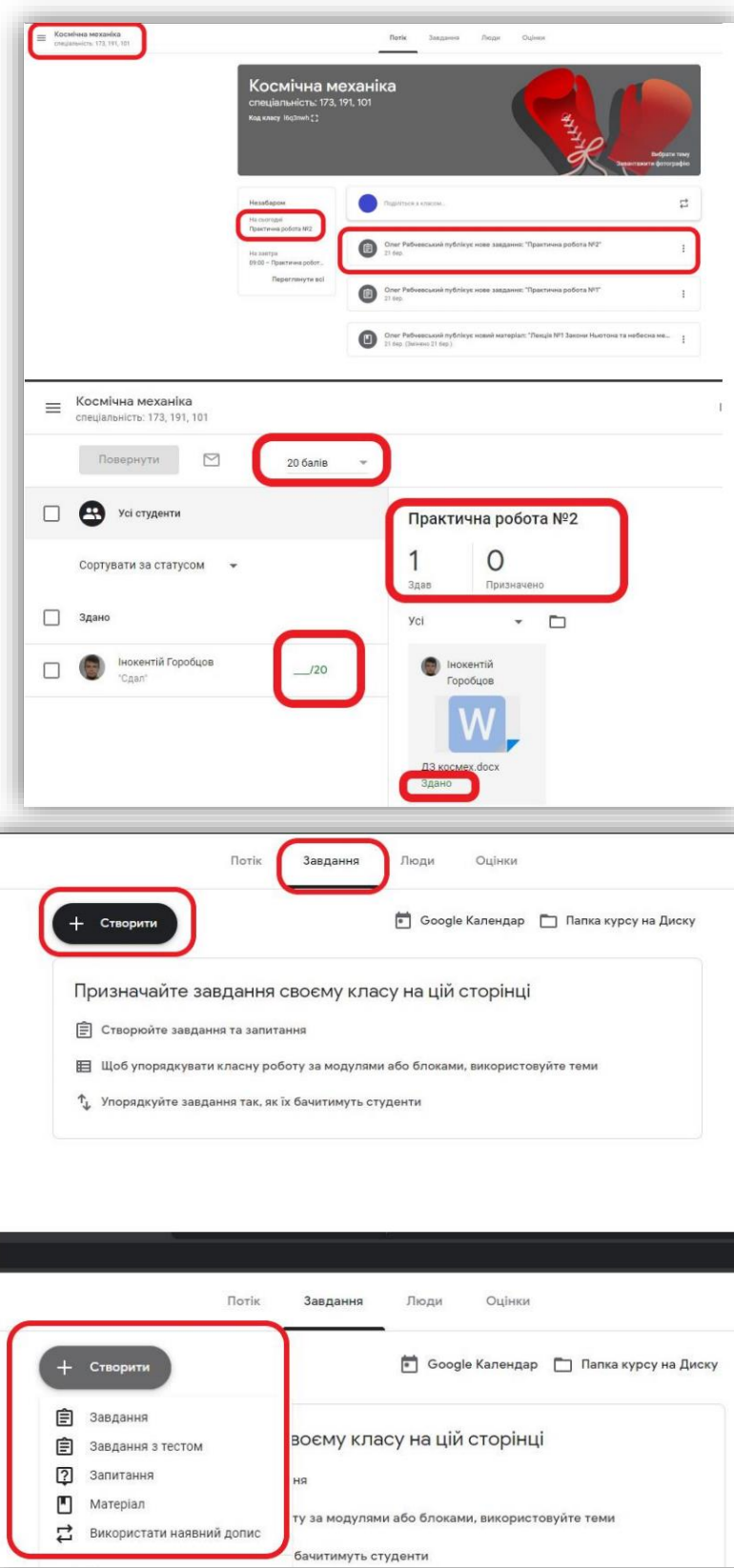


Fig. 5.8 - 5.11 Screenshot of creating a task

8) In the task window you can see on the left - list of listeners and them points for completed tasks above - the maximum number of points for the task you determine independently from the keyboard (or setting "without assessments "); right - status of work: quantity submitted works attached files with works, participant comment to work;

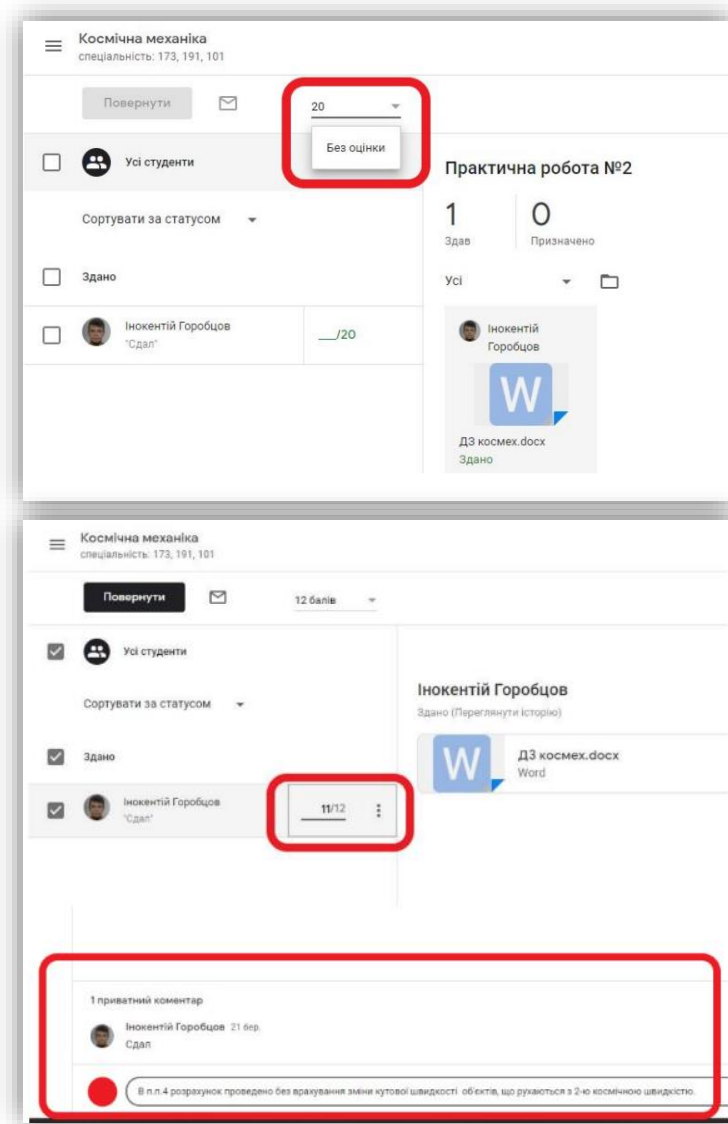


Fig. 5.12, 5.13 Screenshot of adding a file to the task

9) After checking the work, set the number points on which she appreciated. Add comment for necessity. Click "Return", that the listener received in the notification mail about the number of points for completed tasks;

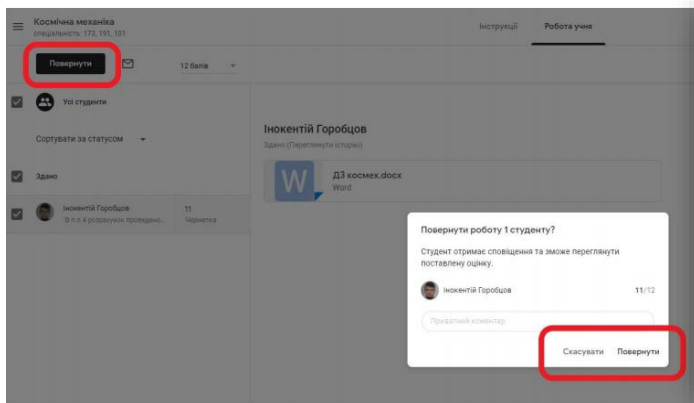


Fig. 5.14 Screenshot of turning task to the listener

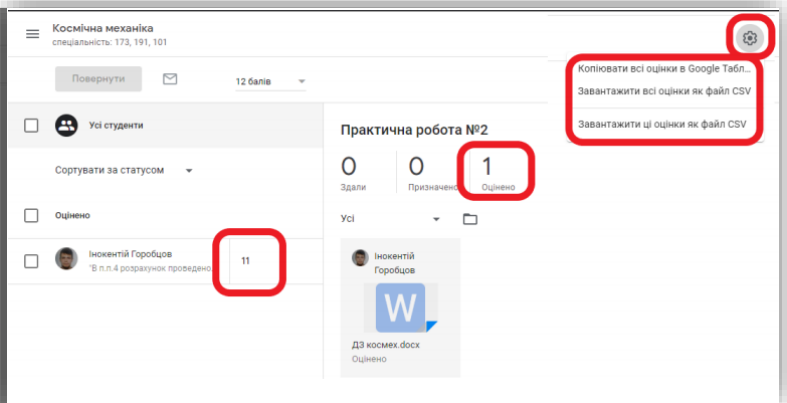


Fig. 5.15 Screenshot of rating the tasks

Job status changed on "Rated". To the listener credited points. By using a gear at the top right you will be able to copy everything flow estimates in the Google table to your further work with it.

10) To conduct current control take advantage task with the test. Test task formed in the ordinary Google form. Check and performance appraisal the test is performed similarly.

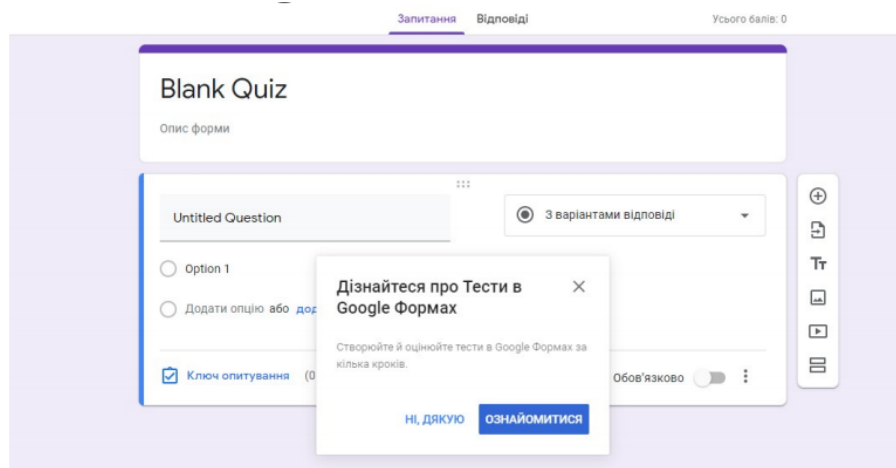


Fig. 5.16 Screenshot of creating the test

Checking the task performed by the same way.

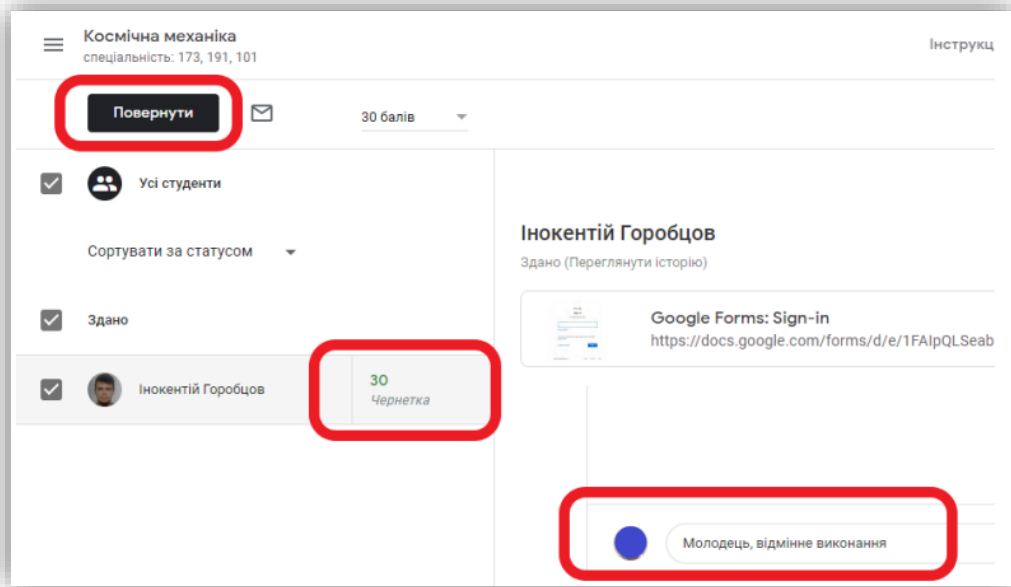


Fig. 5.17 Screenshot of commenting with personnel

5.3 Preparation of the workplace

After reading the instructions for working with the application for conducting an online meeting, we proceed to turning on the equipment and conducting an online lesson.



Fig. 5.18 Photo of teaching equipment: tripod with mobile phone, wireless headphones, lighting equipment.

For correct functioning, follow the instructions:

- 1) Install the tripod in place where the lesson will be conducted;
- 2) Check all equipment before switching on for breakages, cracks, frayed wires;
- 3) Turn on the power for lights;
- 4) Switch the headphones;

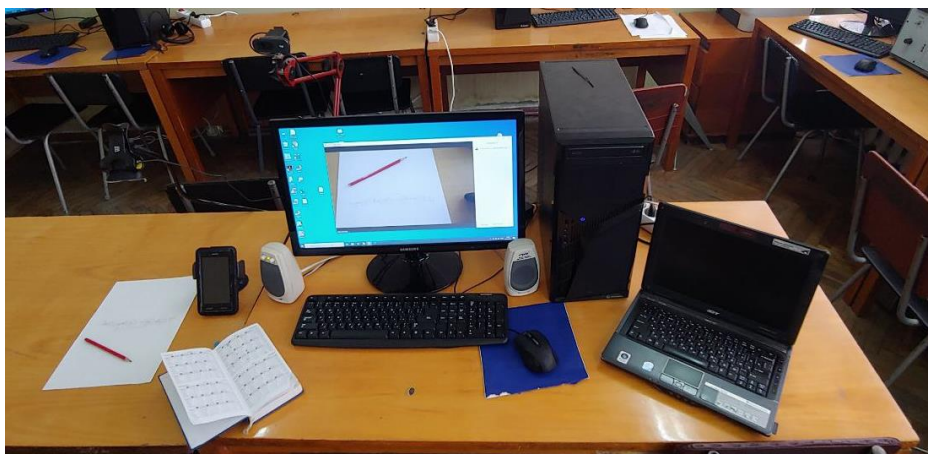


Fig. 5.19 Photo of the front view on the workplace: smartphone, laptop, speakers, two cameras, PC, monitor

- 5) Open the mobile phone;
- 6) Log in to your Google Classroom account;
- 7) Click on the link invitation to the video conference;

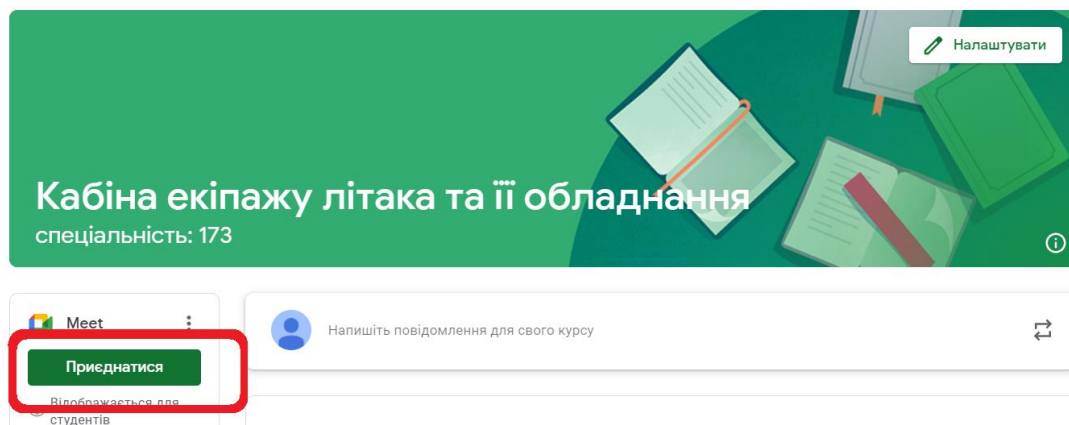


Fig. 5.20 Screenshot of the link

8) Test the microphone and camera work in the Classroom without listeners;

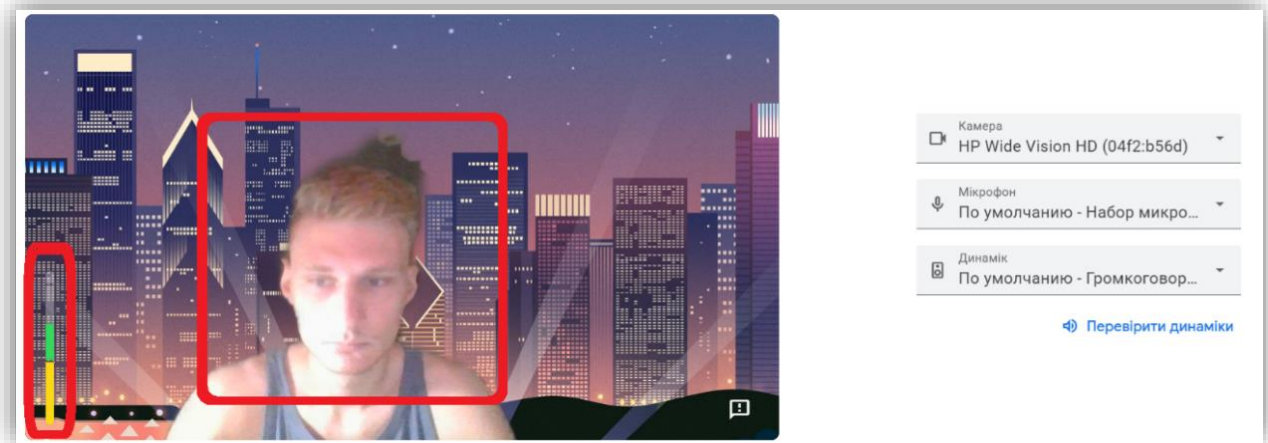


Fig. 5.21 Screenshot of voice and video checking window

9) Enter the video call;

10) Start an online lesson;

11) After the online lesson, turn off Google Classroom, close all enabled applications on the phone;

12) Assemble a tripod;

13) Turn off the power.



Fig. 4.22 Front view on two pilots seats in airplane while major overhaul

In creating a real prototype of the workplace, I managed to assemble the following equipment: a mobile phone with wireless headphones, tripod, some lighting equipment and additional material that could be displayed on another phone or tab, providing detailed information for conducting a lesson for the leader of the lesson. Also, the tripod can be moved to different places on the aircraft for detailed filming of each place that is discussed in a particular lesson.



Fig. 5.23 Footage with ceiling equipment in load compartment



Fig. 5.24 Footage with ready-made jobs for the aircraft crew cabin

Conclusion to chapter

Conducting online lessons requires a lecturer to be able to teach, choose an approach to present information and a teaching method. Modern conditions also require the ability to handle complex equipment and software. Detailed step-by-step switching on, using the setting and working in the remote mode of training the airline personnel.

CHAPTER 6

CONDUCTING A PRACTICE LESSON WITH AIRLINE PERSONNEL

6.1 Lesson introduction

- 1) The goals and objectives of the lesson should be announced at the beginning of the video call, and at the end, summarize - whether all the goals of the lesson have been achieved and briefly summarize the results.
- 2) New material is best explained using familiar vocabulary. Thus, the listener will not only be able to fully concentrate on new information, without being distracted by the search for the meaning of new concepts and terms, but also to repeat those already studied, applying them in a new lesson.
- 3) The studied material must be used in one way or another in subsequent lessons.
- 4) Any material that is given during the lesson will be better assimilated if shown in the video. Thus, the practical benefits of the acquired knowledge become obvious.
- 5) In an online lesson with aviation personnel, priority is given to theory and the ability to apply it in practice. Modeling various technical tasks is one of the most effective ways to consolidate theoretical knowledge. From this point of view, group or pair work gives good results. Pair and group work should be given sufficient time in each lesson.
- 6) In each lesson there should be a concept such as the logic of the lesson. The lesson should become a logical link in the learning chain - a continuation of the previous one and preparation for the next.

<i>Кафедра авіоники</i>				<i>НАУ 22 03 94 000 ПЗ</i>			
<i>Виконав</i>	<i>Коновал В.П.</i>			Application of hardware and software tools for training airline technical staff in avionics	<i>Літ.</i>	<i>Арк.</i>	<i>Акрушів</i>
<i>Керівник</i>	<i>Белінський В.М</i>					<i>55</i>	<i>94</i>
<i>Консульт.</i>	<i>Белінський В.М</i>				173 «Авіоніка»		
<i>Н-контр.</i>	<i>Левкієвський В.В</i>						
<i>Зав. каф.</i>	<i>Грищенко Ю.В.</i>						

6.1.1 Plan of the lesson

Theme: Pilot`s flight-control and navigation equipment in crew cabin

1) The purpose of the lesson;

Listeners should familiarize themselves with the technical description of the Crew cabin of An-26 and its equipment and study its characteristics.

2) The task is to study and make reports on the following issues:

- General Avionics of pilots dashboards;
- Functions of each crew member workplace;
- Controls and indications in An-26 cabin.

6.2 An example of an practice lesson

Theme: Pilot`s flight-control and navigation equipment in crew cabin

In this lesson, we will consider the aeronautical equipment that is located in zone 2 - the cockpit. Here are the main instruments and devices for controlling, monitoring the parameters and piloting the aircraft. Let's first look at the equipment that is designed to work for pilots.

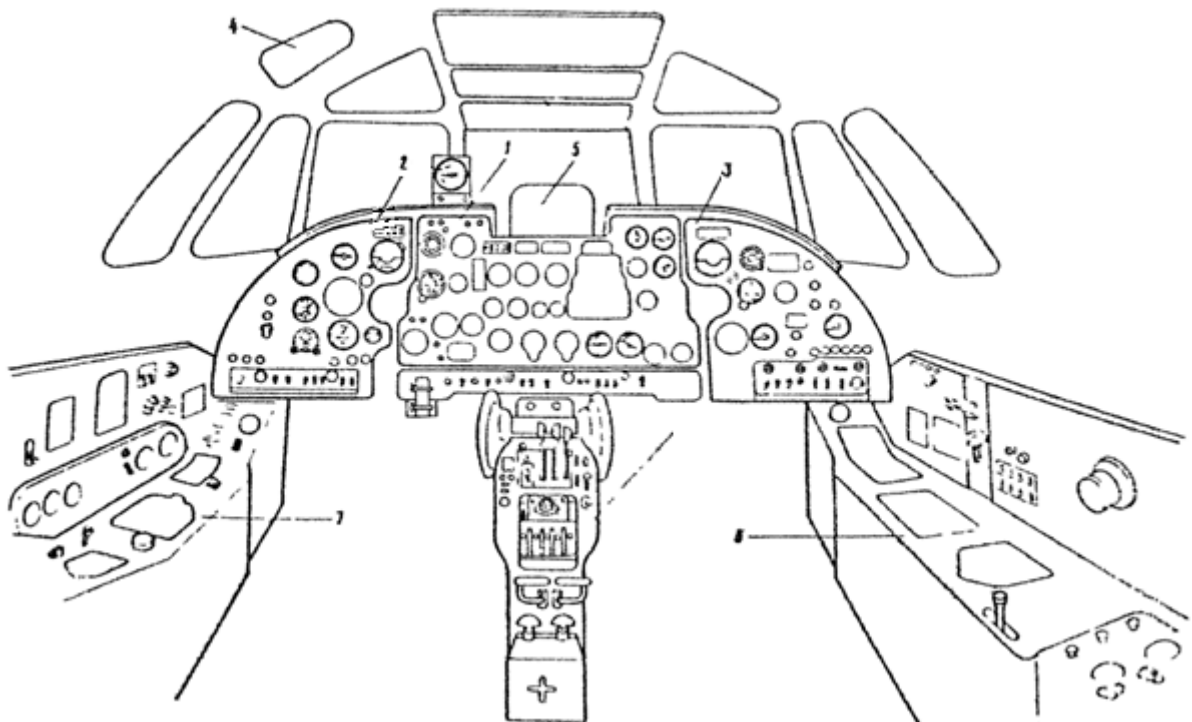


Fig. 6.1 Scheme of pilot`s flight-control and navigaion equipment in crew cabin

1 – Installation of middle pilots` instrument panel, 2 - Installation of glare shield and ИВ-41 indicator, 3 - Pilots' central control pedestal layout, 4 - Vibration instruments installation, 5 - Pilot's e radaroscope and КИ-13 compass installation, 6 - An-26 airplane check list, 7 - Pilot 's left control console instalation, 8 - Pilot 's right control console instalation.

Pilot`s control panels

Structurally, the dashboard consists of three unrelated flat panels: left (LGD), middle (MGD) and right (RGD). Each panel is attached to the structural elements through standard shock absorbers. A visor is installed above the dashboard, which serves to protect the instrument scales mounted on the board from solar glare.

The front sides of the panels and the visor are covered with black paint. To facilitate the installation and dismantling of devices, the middle panel is designed to fold down by turning around its lower edge. The right and left panels are made easily removable.

For ease of review and use, switches for instruments, units, systems and other equipment on the left and right panels are mounted on separate shields, which are bent towards the pilots. A panel with switches is installed under the middle panel of the dashboard, which is attached obliquely to the panel.

On the visor are installed: YACII pointer - above the middle panel of the dashboard, on the left and signal board blocks - above the left and right panels of the dashboard. Above the canopy on the cockpit canopy, there is a radar indicator, indicators of the ИВ-41BM onboard vibration-converting equipment, position indicators for the output shaft ИМ-24 of the ППТ-24 temperature limiting system, and a КИ-13 magnetic compass.

The instruments on the panels of the dashboard are located as follows: on the left panel and the upper left part of the middle panel, the main flight and navigation instruments of the left pilot are located. In the upper right part of the middle panel are the flight and navigation instruments of the right pilot. The rest of the middle panel is occupied by instruments that control the operation of engines, the fuel system, systems for cleaning and releasing the landing gear, flaps, air intake from engines for pressurization and pressurization of the cabins, as well as signal lamps and displays of various systems.

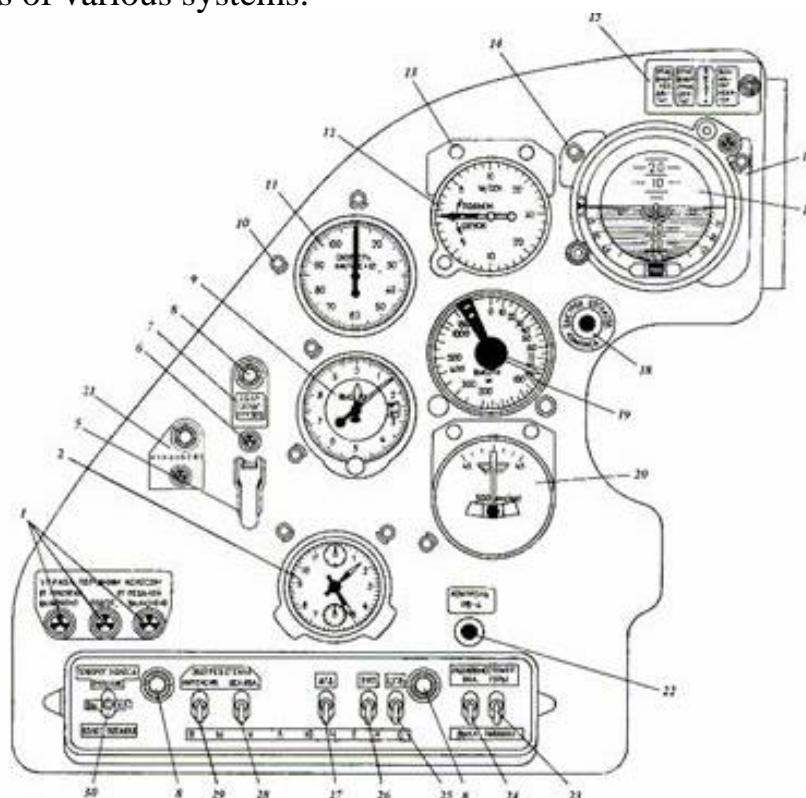


Fig. 6.2 Left pilot instrumental panel (LGD)

1 - signal lamp "Front wheel control" from the handle, from the pedals; 2 - hours; 5 - switch "Emergency cargo drop"; 6 - signal lamp "Emergency dumping of cargo"; 7 - stencil; 8 - backlight fittings; 9 - altimeter; 10 - red light lamp; 11 - combined speed indicator; 12 – variometer BAP-30MK; 13, 14, 16 - red lamps; 15 – signal board ("Danger of vibration of the left engine", "Danger of vibration of the right engine", "Altitude", "Attention, locator"; 17 – АГД-1 attitude indicator; 18 – button "Quick compass alignment"; 19 - radio altimeter indicator PB-4; 20 - electric direction indicator; 21 - signal lamp "Failure 6201"; 22 - button "Control

PB-4"; 23 - radio altimeter switch "Mountains-Plain"; 24 - switch "Radio altimeter"; 25 - switch "ЦГВ"; 26 - switch "ЭУП"; 27 - switch "АГД"; 28 - switch "Glass heating reduced"; 29 - switch "Glass heating intensive"; 30 - switch for controlling the rotation of the wheel.

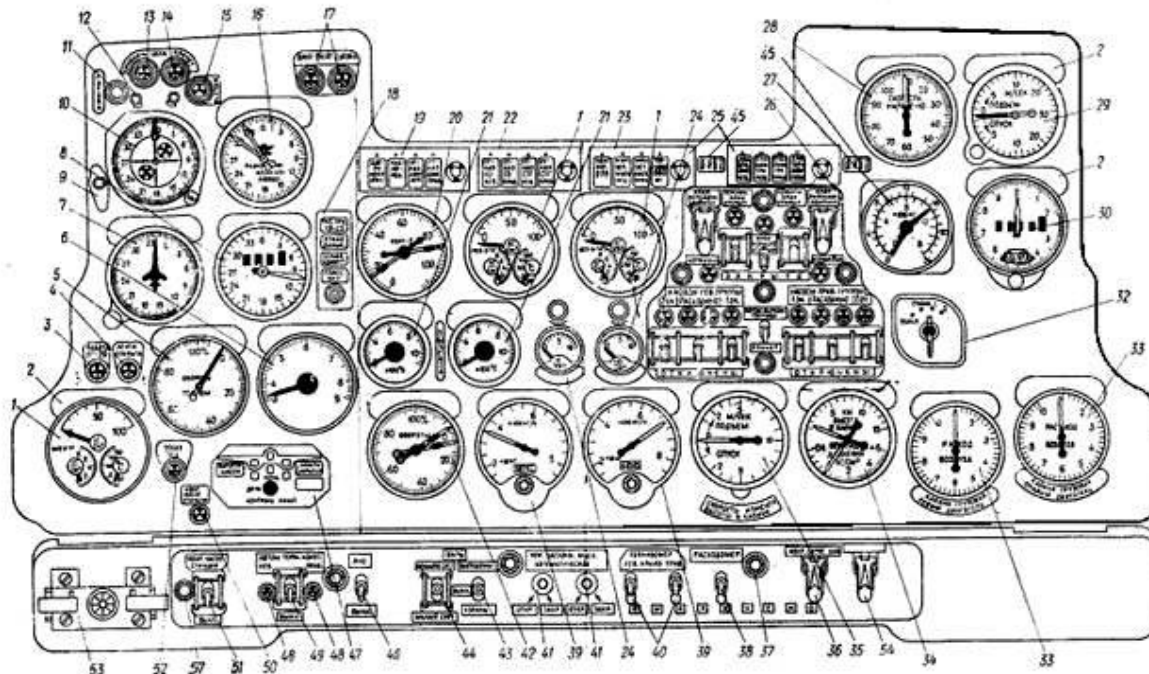


Fig. 6.3 Middle instrumental panel of pilots (MGD)

1 - three-pointer motor indicators; 2, 9, 12, 31 - red lamps; 3 – signal lamp “Work of ПТ-29”; 4 – signal lamp “Tape is open”; 5 - tachometer indicator; 6 – APU exhaust gas temperature gauge; 7 - course setter; 8 - direct-reading device of range and azimuth; 10 - combined flight and landing instrument; 11 – “Ready” button; 13 – signal lamp “Target Approach”; 14 - signal lamp "Span of the target"; 15 – signal lamp “Marker”; 16 - APK-11 radio compass pointer; 17 - signal lamps "The screw is removed from the stop"; 18 – signal board (“Operating KB-CB TX”, “Long range failure”, “Azimuth failure”, “Gliss. on”; 19 – alarm board (“Doors, hatches open”, “Oxygen”, “ Right engine failure", "Left engine failure"; 20 - position indicators of the levers of the engine fuel units; 21 - exhaust gas temperature indicators; 22 - signal board ("Failure of the HE left.", "Failure of the ГО right.", “Failure of CTF left”, “Failure of CTF right.”); 23 – signal board (“Emergency power supply 27 V”, “Min. remaining oil. left”, “Min. remaining oil. right.” , “Fuel 680 kg”; 24 – torque gauge indicator; 25 – signal board (“Fuel pressure, left

engine”, “Left filter failure”, “Right filter failure”, “Fuel pressure, right engine .?”; 26 - fuel shield with switches and signal lamps; 27 - fuel gauge indicator; 28 - combined speed indicator; 29 - variometer; 30 - УВИД 30-15 altimeter; 32 - fuel gauge switch; 33 - air flow indicator; 34 - indicator altitude and differential pressure; 35 - variometer; 36 - switch "Emergency pressure release"; 37 – low backlight fittings; 38 – “Flowmeter” switch; 39 - fuel consumption indicators; 40 – fuel gauge switches; 41 - switches "Oil cooler damper control"; 42 - engine tachometer meter; 43 - switch "Headlights released-retracted"; 44 - switch "Headlights big light-small light"; 45 - signal board “Chips in engine. a lion. (rights)”); 46 - switch "AHO"; 47 – flight and landing device; 48 - signal lamps "Automatic wheel braking"; 49 - switch "Automatic wheel braking"; 50 - signal lamp for emergency activation of the pumping station; 51 - switch "Emergency pumping station"; 52 - signal lamp “TCAS failure”; 53 - trimmer emergency control panel; 54 - switch "Disabling the blocking of the landing gear.

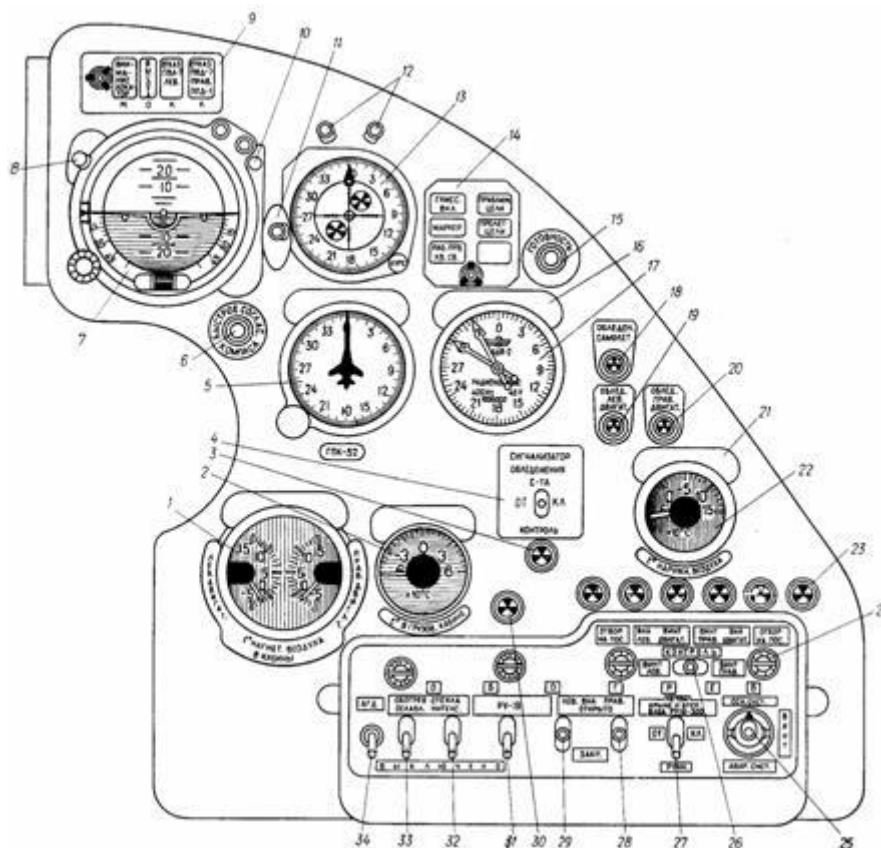


Fig. 6.4 Right pilot instrumental panel (RGD)

1 - temperature indicator of the air injected into the cab (from the set 2TYЭ-111); 2 - air temperature gauge in the cargo compartment (from the TB-19 kit); 3 – signal lamp for aircraft icing alarm control; 4 – aircraft icing alarm switch; 5 - course setter; 6 – button “Quick compass matching”; 7 - indicator of the artificial horizon (from the АГД-1 set); 8, 10, 11, 12, 16, 21 - red lamps; 9 - signal board (“Attention locator”, “Height”, “Failure ПВД-7 left”, “Failure ПВД-7 right. ПВД-1”); 13 - combined flight and landing instrument; 14 - signal board (“Gliss. on”, “Marker”, “KB-CB TX is working”, “Approximate target”, “Target flight”); 15 – “Ready” button; 17 - APK-11 radio compass pointer; 18 – signal lamps “Aircraft icing”; 19 – “Icing of the left engine”; 20 – “Icing of the right engine”; ; 22 - outdoor air temperature indicator (from the THB-15 kit); 23 - signal lamps of the heating system of individual units; 24 – backlight fittings low; 25 – propeller heating switch from the main and emergency systems; 26 - heating control switch for the left and right propellers; 27 - switch “Wing and plumage, input PY19-300, automatic. – off. – manual”; 28.29 - BHA heating switches; 30 – signal lamp “Heating PY19-300”; 31 - additional engine heating switch; 32 - switch "Glass heating intensive"; 33 - switch "Glass heating is weakened"; 34 – “АГД” switch.

On the right panel there is a second set of flight and navigation instruments and devices that control the temperature of the injected air in the cockpit, inside the cockpit and outside the aircraft, warning lamps for aircraft and engine icing, warning lamps for the operation of the anti-icing system and a panel with switches for this system, as well as switches for navigation devices . Switches and switches for aircraft systems, engines and aircraft equipment control are installed on the switch panel. On the dashboard, directly in front of each device, there are individual lighting fixtures, etc.

Left control console

The left control console is installed on the port side between frames No. 3...5. It consists of two panels - horizontal and vertical. For access to the units installed inside the console, there are removable hatches in the side walls.

On the vertical panel of the control panel there are rheostats for lighting with red light, a CИY-7 subscriber unit, a voltmeter and an ammeter of the starting system, an X-ray meter console, and a red lamp. At the bottom of this panel there is a shield with indicators of pressure in the hydraulic system and brakes, the amount of hydraulic mixture and the amount of oil in the engine tanks.

On the horizontal panel of the front panel there are valves for turning on the emergency hydraulic system and a windscreen wiper, an emergency shutdown switch for the autopilot steering machines, a control handle for turning the front wheels, and under the hinged cover there is a shield for starting the АИ-24ВТ and PY19A-300 engines. On the rear inclined horizontal panel, there are power taps for devices from full and static pressure systems and a hatch for a bag with an oxygen mask, etc.

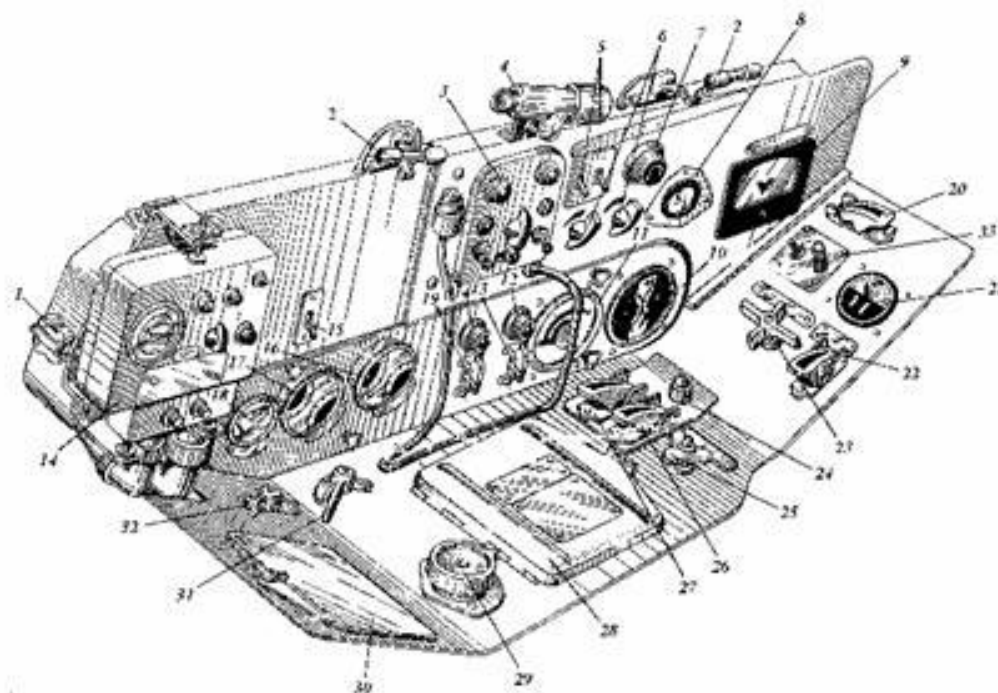


Fig. 6.5 Left control console.

1 - oxygen valve; 2 - lamps of red light; 3 – subscriber unit; 4 - red light lamp; 5 - pilots' dashboard lighting switches; 6 - transformers for lighting with red light of the middle and left panels of the pilots' dashboard; 7 – red light rheostat of the left side of the cockpit; 8 - current control ammeter at startup; 9 - voltage control

voltmeter when starting engines; 10 - oil gauge pointer; 11 - indicator of the amount of slurry; 12 - signal lamp for the open position of the air intake flap of the APU; 13 – APU air intake flap control switch; 14 – radiometer console; 15 – clock heating switch; 16 - gauge pointer 2ДИМ-150 “Brake pressure”; 17 - gauge indicator 2ДИМ-240 “Pressure in the main system” and “Pressure in the hydraulic accumulator”; 18 - pointer of the pressure gauge ДИМ-240 “Pressure in the emergency system”; 19 – APU fire hydrant control switch; 20 - emergency opening emergency hatch switch; 21 - pressure gauge - indicator; 22 - emergency shutdown switch for autopilot steering gears; 23 - valve for switching on emergency pressure in the main hydraulic system; 24 - signal lamp "Emergency reset of suspensions from the DB"; 25 - tap for switching on the wiper. 26 - “Explosion-Non-explosion”; 27 - “Reset-Off. ”; 28 - a shield for starting the main engines and an additional engine; 29 - the handle for turning the front wheel; 30 - hatch for a bag with an oxygen mask; 31 - valve for supplying devices from the full pressure system; 32 - power supply valve for devices from the static pressure system; УАЩ check box.

Right control concole

The right control console is installed on the starboard side of the aircraft between frames No. 3 ... 5. Structurally similar to the left panel.

On the horizontal panel of the console are installed: a shield with SCR control switches, a panel for monitoring and controlling heating ПВД-7 and ППД-1, a pressure gauge-indicator ИК-18М, a lower emergency hatch control valve, a hatch for a bag with an oxygen mask, a САРД command device, a crane wiper control.

On two vertical easily removable panels of the console there are control panels for radio equipment, an oxygen device КП-24М, a control panel for signal rockets, an oxygen valve KB-2МС, a valve for switching the power supply of devices from a static system, rheostats for lighting the starboard side and the right

panel of the dashboard with red light, adjustment rheostats brightness of combat lights, control switch MCPИ-12, etc.

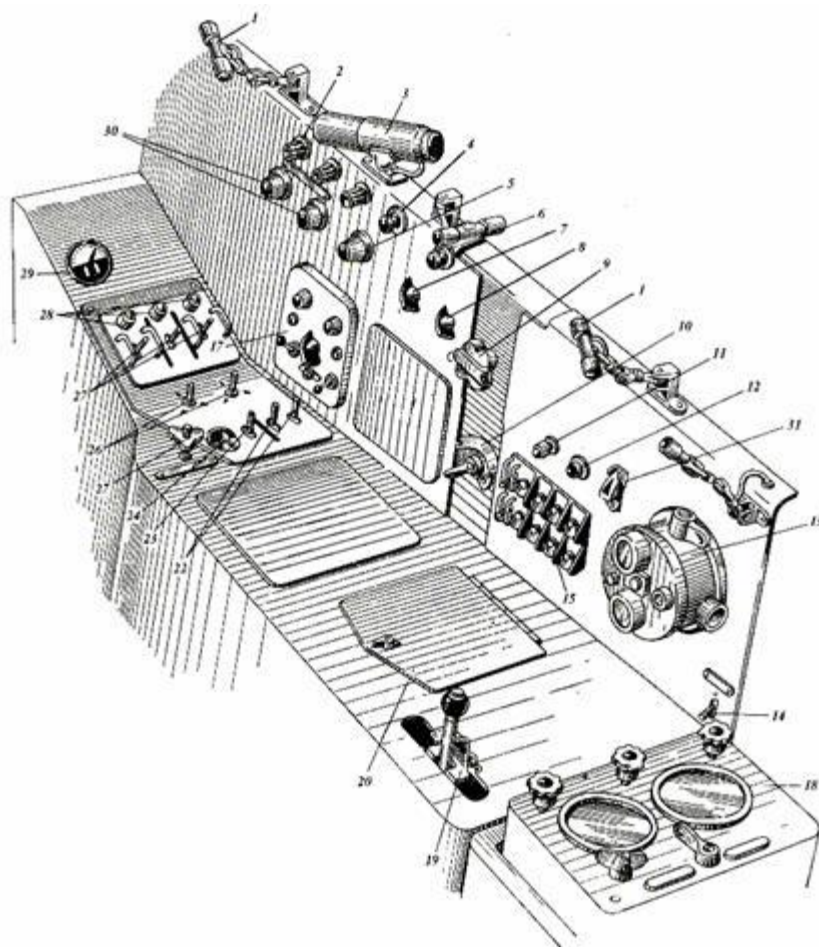


Fig. 6.6 Right control concole

1, 3 - lamps of red light; 2 - fuses for lighting control panels and ППППД pilots; 4 – button “Turn on the siren”; 5 - rheostat for lighting the starboard side of the aircraft with red light; 6 – button “Intermittent alarm control”; 7, 8 - transformers for lighting with red light for ППППД and control panels; 9 - oxygen valve; 10 - power supply valve for devices from the static pressure system; 11 – signal lamp of JИПИ operation of MCPИ-12 recorder; 12 - button for checking the LMP of the MSRP-12 recorder; 13 - oxygen device; 14 - switch for lighting the front landing gear; 15 - remote control signal rockets; 17 - subscriber unit; 18 - command device APД; 19 – emergency hatch control valve; 20 - hatch for a bag with an oxygen mask; 22 - switches for manual temperature control in the cabins of the right and left systems;

23 - switch “Automatic. – manual” temperature control in the cabins; 24 - switch of the temperature controller; 25 - wiper tap; 26 - switches for controlling the air supply to the cabins; 27 - heating switches for receivers ПВЛ-7 and ППД-1; 28 - signal lamps for the health of the heating of the receivers ПВД-7 and ППД-1; 29 - pressure gauge - indicator; 30 - rheostats for adjusting the brightness of combat lights; 31 – “MCPII control” switch.

Middle control concole

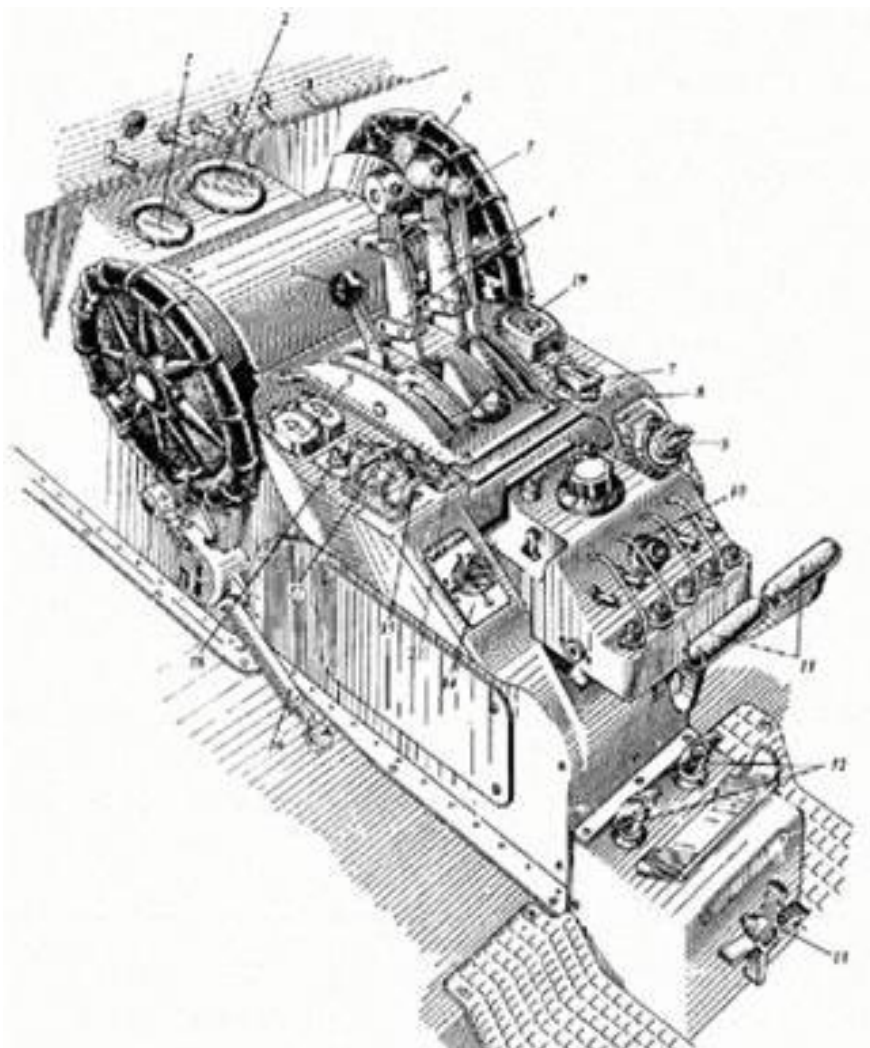


Fig. 6.7 Middle control concole scheme

1 - indicator of the position of the flaps; 2 - indicator of the position of the oil cooler flaps; 3 – APU control lever; 4 – engine control levers; 5 – engine stop switches; 6 – steering wheels for controlling the trimmers of the elevator; 7 – switch for emergency release of flaps; 8 – lever for shifting stops of in-flight idle gas; 9 - switch for releasing and retracting the landing gear; 10 – autopilot control

panel; 11 – emergency braking levers; 12 - handles for hydraulic propeller feathering and engine shutdown; 13 - drain valve of the chassis release system; 14 - switch for cleaning and releasing flaps; 15 – rudder trim control switch; 16 – steering wheel locking handle; 17 – aileron trim control switch; 18 – signal lamps of the disabled position of the rudder and aileron trimmers; 19 - switch for removing screws from the stop; 20 – braking handle of engine control levers; 21 - signal lamps for the neutral position of the rudder and aileron trimmers.

Upper shield

The upper shield is installed on the cockpit canopy and is intended for placement on its panels of panels and control panels for radio and electrical equipment, aircraft and propulsion systems. Structurally, the top shield consists of four panels: bottom, middle, left and right.

On the bottom panel there are control panels for the MC-61B tape recorder and the C3M station, switches and switches APK-11, APK-УД, P-863, CO-69 and ed. 6201.

On the middle hinged panel there are P-863 radio control panels, two "START THE ENGINE IN THE AIR" switches, an C3M-5M unit from the C3MТ, signal lamps and propeller feathering buttons, and a fire extinguishing system shield.

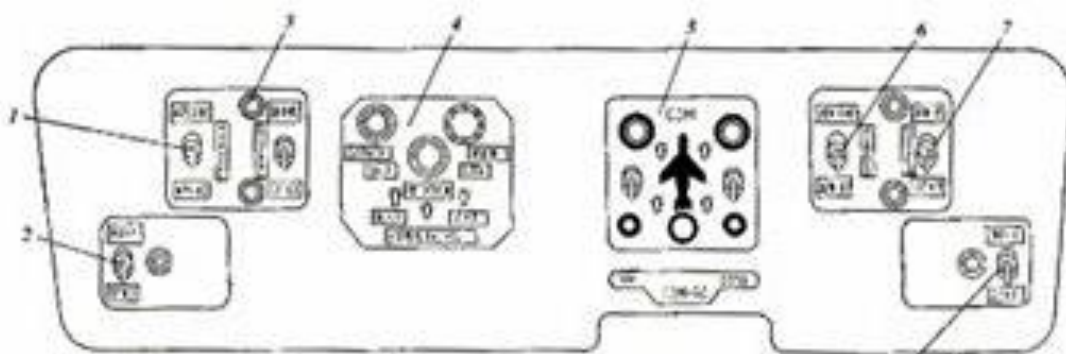


Fig. 6.8 The lower panel of the upper shield of the pilots.

1, 6, 7, 8 - switches; 2 - switch; 3 - low illumination reinforcement; 4 - tape recorder control panel; 5 - block from the C3M kit; 9 - power adjustment switch.

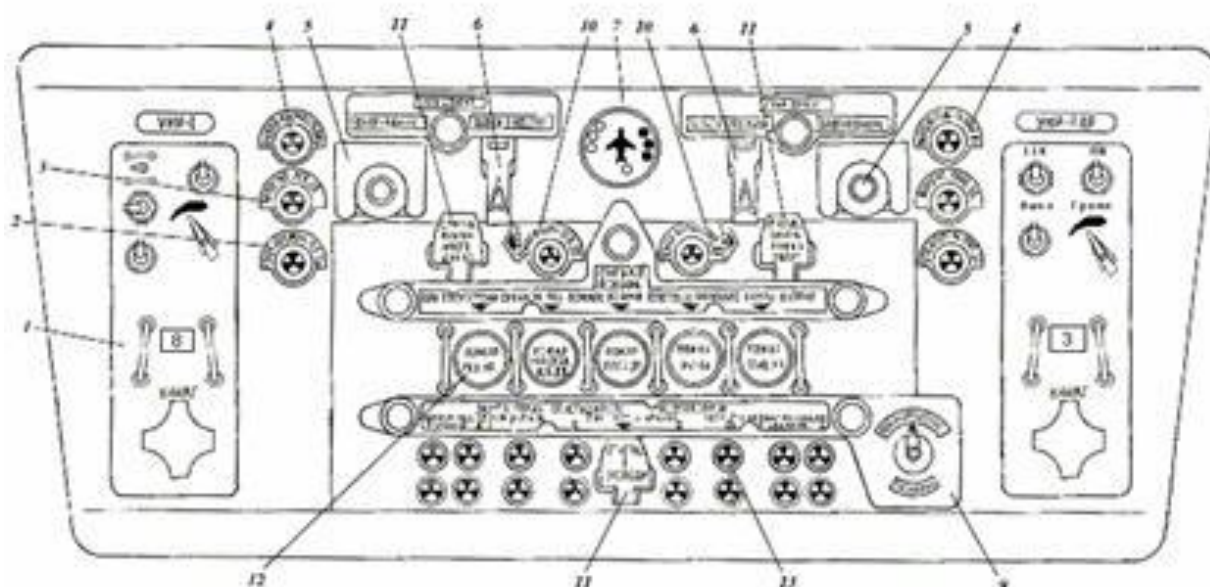


Fig. 6.9 The middle panel of the upper shield of the pilots.

1 - control panel for VHF radio station P-863; 2 - signaling lamp for the readiness of propeller autofeathering; 3 - propeller feathering alarm lamp; 4 - signaling lamp for the withdrawal of propellers from the weather vane; 5 - propeller feathering buttons; 6 - switches for starting engines in the air; 7 - block from the C3M kit; 9 - switch "Fire extinguishing-Check"; 10 - fire alarm lamps inside the engines; 11 - buttons for manual activation of fire extinguishers; 12 - button lamps for signaling a fire; 13 - signaling lamps for the preparation of fire extinguishers.

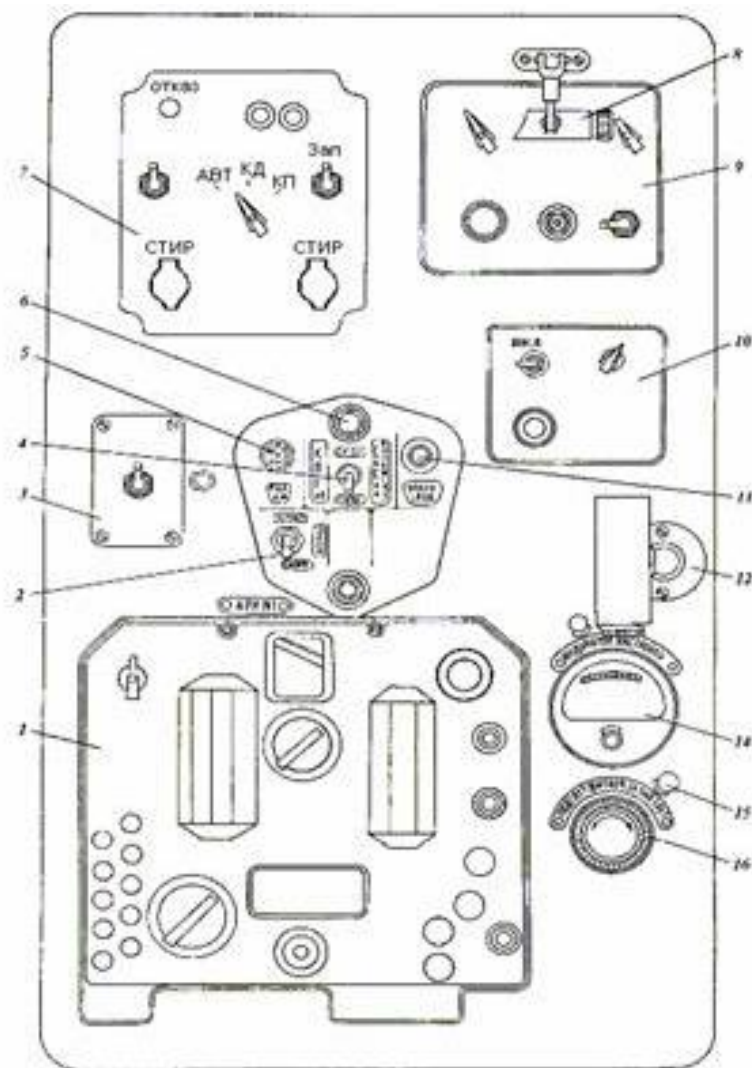


Fig. 6.10 The left panel of the upper shield of the pilots.

1 - control panel for the АРК-11 radio compass; 2 – transponder switch; 3 - button "Explosion" of the transponder; 4 - switch "СП-50 РСБН-2С"; 5 - signal light; 6 - low illumination reinforcement; 7 – transponder control panel; 8 - lamp; 9 - control panel of the РСБН-2С station; 10 - control panel for the СП-50 system; 11 - button "Identification" station РСБН-2С; 12 - lamp; 13 - switch of the СП-50 system; 14 - setting indicator; 15 - lamp; 16 - shield illumination rheostat.

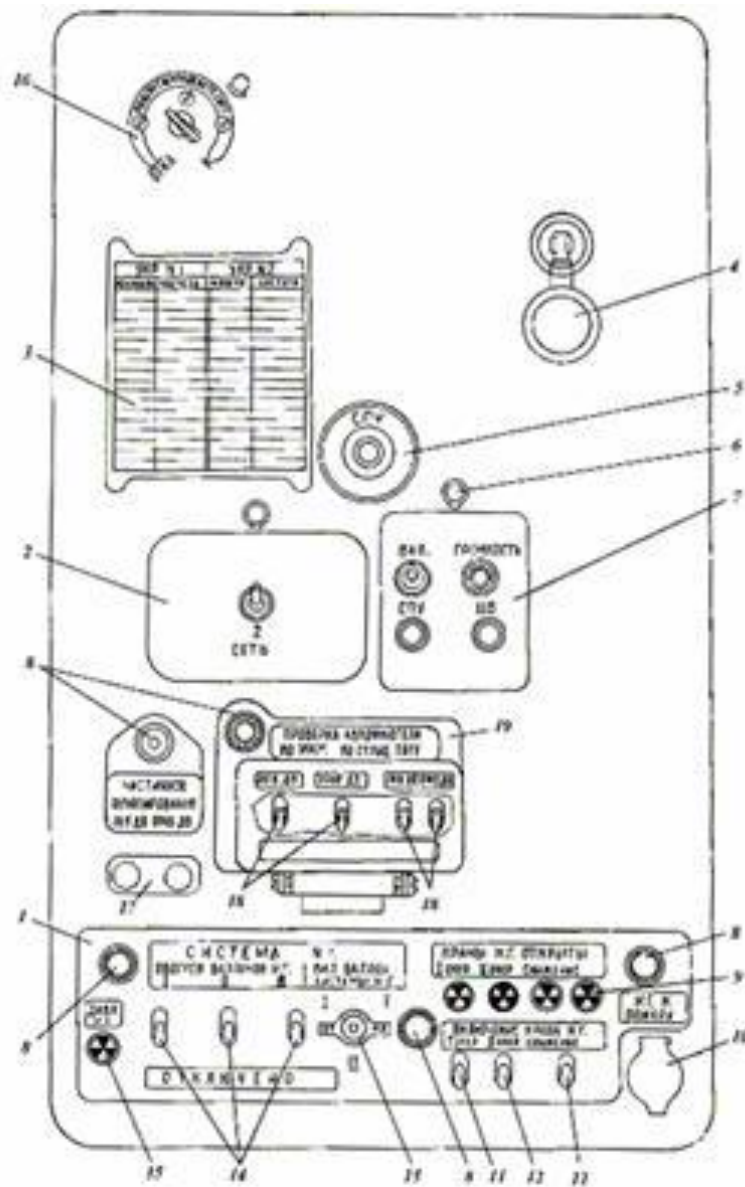


Fig. 6.11 The right panel of the upper shield of the pilots.

1 - control panel for the NG system; 2 - simplified subscriber unit; 3 - stencil of radio stations P-863 No. 1 and R-863 No. 2 (YKP No. 1, YKP No. 2); 4 - lamp; 5 - SPU button; 6 - lamp; 7 - the equivalent of a manual tangent; 8 - low illumination reinforcement; 9 - signal lamps for opening the taps of the NG system; 10 - button for turning on OCV-5 fire extinguishers in the fire fighting system; 11 - switches of the cranes of the NG system "I stage - Lowering"; 12 - switch of taps of the HF system "Phase II"; 13 - switch for switching on NG cylinders; 14 - switches for turning on NG cylinders; 15 - signal lamp "LP pressure"; 16 - rheostat-transformer; 17 - buttons for partial feathering of engine propellers; 18 - switches for checking the autovane; 19 - shield for checking the autovane;

Navigator's workplace

The navigator's workplace is located at the left side of the cockpit, behind the left pilot between frames No. 5 ... 7. Between frames No. 5 and No. 6, behind the seat of the left pilot, a shelf is mounted on which are installed: an instrument panel, a control panel and a control unit for the CPII, the PCBH-2C radio navigation system, an upper shield, a reset shield, a Groza radar station unit, a gyro semi-compass ГПК-52AP. In addition, a panel with radio control panels is installed on the left side of the fuselage between frames No. 5 ... 7.

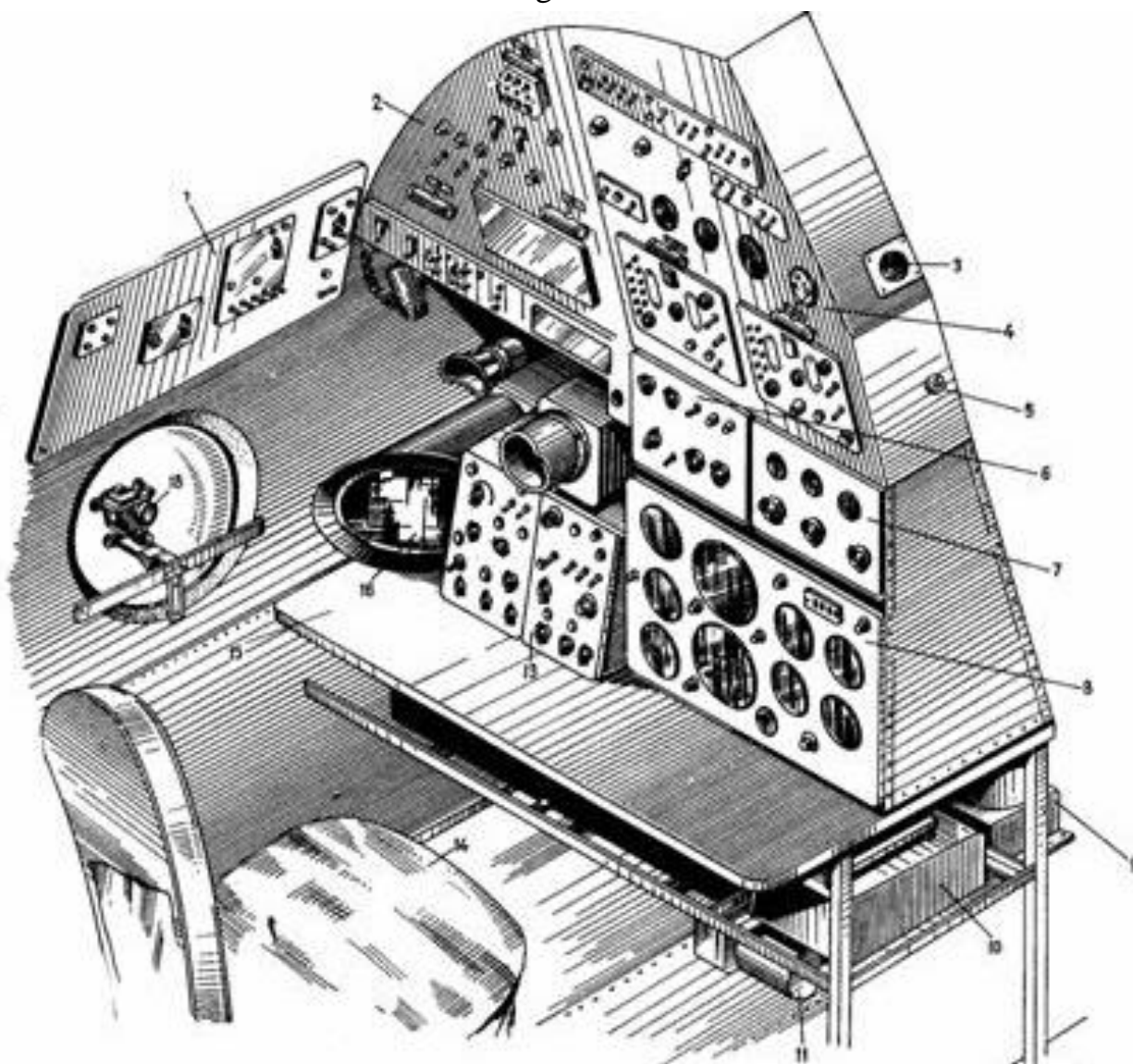


Fig. 6.12 Navigator's workplace scheme.

1 - panel with control panels for radio equipment; 2 - reset shield; 3 - pressure gauge-indicator ИК-18 flight engineer; 4 - top shield; 5 - CPII button; 6 - control

panel for the РСБН-2С system; 7 - control unit СРП РСБН-2С; 8 - dashboard; 9 – gyro unit Г-3М; 10 - remote block DP-3В; 11 – corrective mechanism of КМ; 13 - block 2НВ-4ІІІ of the radar station РСБН-3Н; 14 - armchair; 15 - table; 16 – gyro-semicomputer ГПК-52АР; 18 - sight НКПВ-7С.

Workplace of the radio operator

The radio station workplace is located on the starboard side of the cockpit, behind the right pilot. The radio operator sits facing the wall of frame No. 7, where the following are installed: an electrical panel, a panel with radio equipment shields and oxygen equipment, devices, a panel with AC fuses, a bookcase with radio equipment blocks, a table. On the starboard side between frames No. 5 and No. 6, a gas station shield and a cockpit RC are installed.

The radio operator's electrical panel is located on the other side of the table with the control panel of the arch panel and the fuse box. Its main purpose is to distribute current throughout the aircraft, launch alternative energy sources, start the engine from a generator or from a ground power source. It has a number of devices indicating the characteristics of the current that is supplied to the devices.

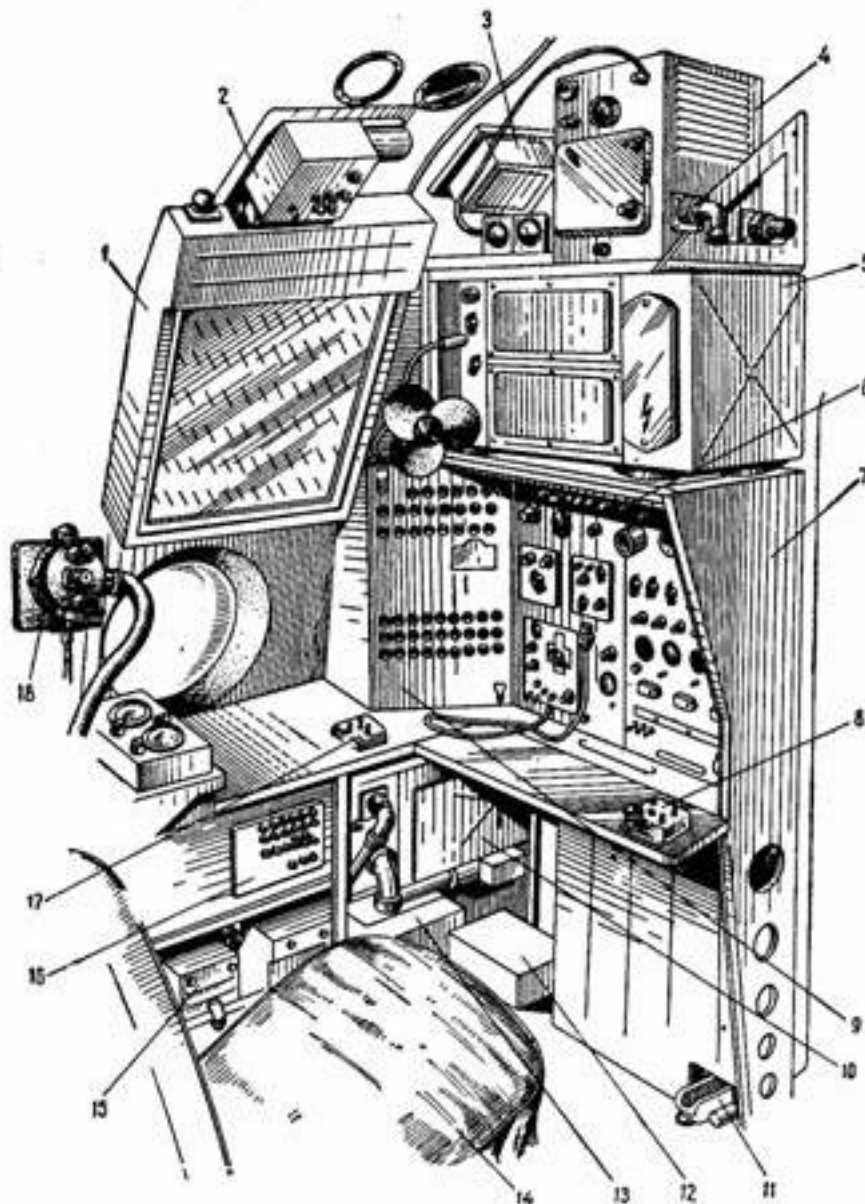


Fig. 6.13. Radio operator's workplace (early series):

1 - Gas station shield; 2 - РК of ДИМ devices; 3 – box of antenna relays; 4 – СПВ-5 transmitter; 5 – P-846 transmitter; 6 - panel with shields of radio equipment; 7 - electrical panel; 8 - telegraph key; 9 - panel with 11 and 36 V AC fuses; 10 - radio receiver; 11 - foot tengenta; 12 -; transformer; 13 - power element of the CB transmitter; 14 - armchair; 15 - fuel gauge measurement unit; 16 - РК cockpit; 17 - control panel MC-61; 18 - oxygen device КП-24М.

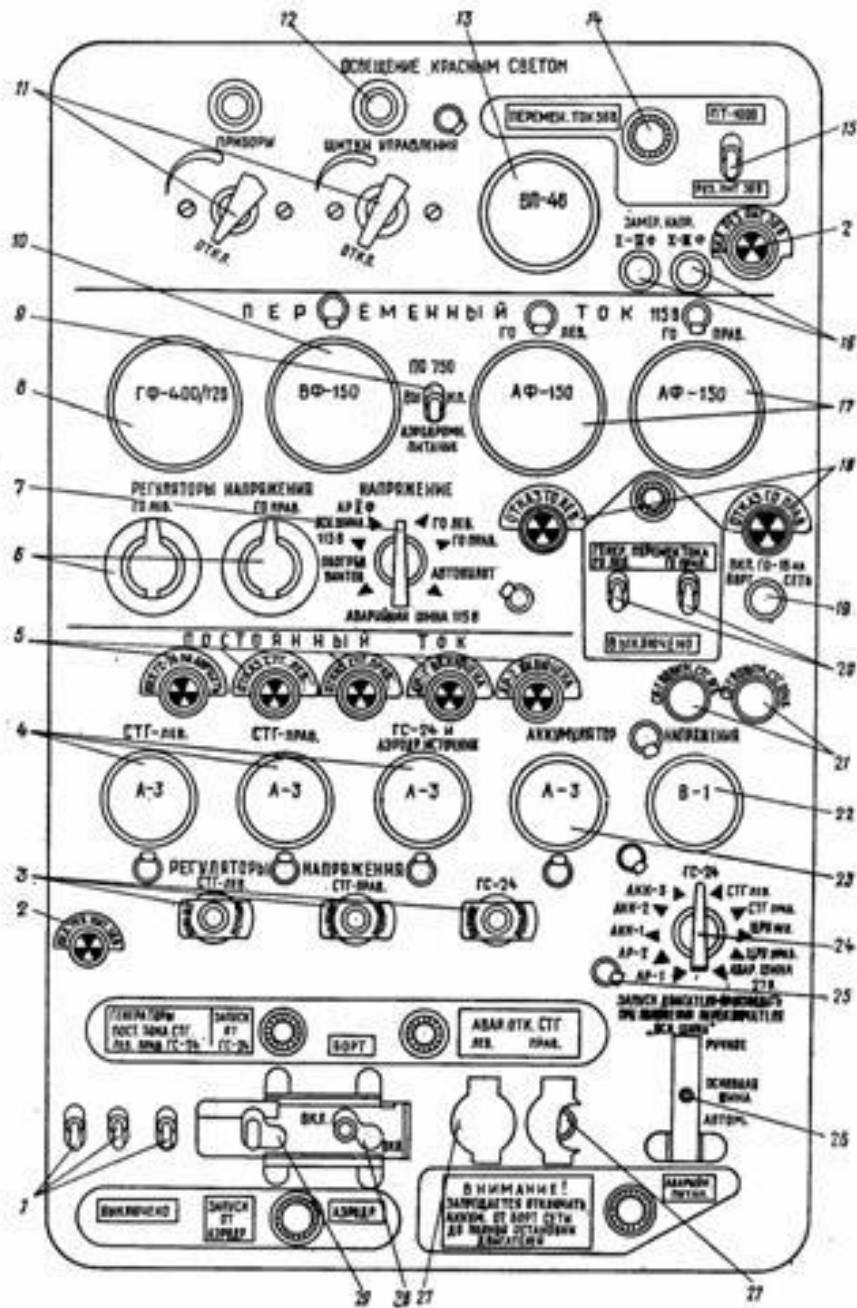


Fig. 6.14. Radio operator's electrical panel:

1 - switches of the ГС-24 generator, left and right СТГ; 2 - signal lamps for switching on the backup power supply 36 V; 3 - remote resistance STG lev. ", "ГС-24"; 4 – DC ammeters "СТГ lev. ", "СТГ is right. ", "ГС-24 and aerodrome. source"; 5 - signal lamps "On. ГС-24 to the onboard network", "AP-21 is on", "AP-2 is on", "STG failure lev. "; 6 - remote resistance of the left and right ГО; 7 - voltage test switch; 8 – AC hertzmeter; 9 - switch for switching on the converter ПГО-750 and airfield power; 10 - AC voltmeter; 11 - red lighting transformers for

instruments and shields; 12 - fuses for lighting with red light; 13 - voltmeter; 14 - low illumination reinforcement; 15 - switch for switching on the ПТ-1000 converter and backup power; 16 - buttons for measuring the voltage of I-III and II-III phases; 17 - AC ammeters; 18 - signal lamps for the failure of the operation of the left and right ГО; 19 - button for turning on the ГО-16 to the onboard network; 20 - switches for switching on alternating current generators; 21 - fuses of СТГ voltmeters of the left and right; 22 - DC voltmeter; 23 - battery ammeter; 24 - voltmeter switch; 25 - lamp; 26 - emergency power switch; 27 - button for emergency shutdown of excitation of the left and right СТГ generators; 28 - power switch "Airfield - Board"; 29 - turbogenerator switch.

Conclusion to chapter

In this chapter, I gave an example of conducting a practical lesson with airline personnel on the theme: crew cabin and its aeronautical equipment. This system is the next link in the development of onboard equipment. It includes multifunctional devices, flight characteristics sensors and information transmitters, which are installed in a special place in An-26. The material was taught in the form of theory, drawings and explanations to them. In addition to the material, a practical excursion on the aircraft was conducted with video broadcasting to better familiarize the crew members of the aviation company with the material and the location of modules and assemblies.

CHAPTER 7

LABOUR PROTECTION

7.1. Introduction

Practically all labor protection measures are based on legislative and regulatory provisions. The main legislative act is the Constitution of Ukraine.

According to the Law of Ukraine "On Labor Protection", indicators of working conditions at the workplace, characteristics of technological processes, machines, mechanisms, equipment and other means of production, the condition of the means of collective and individual protection used by the employee, as well as sanitary and household conditions must meet the requirements regulatory acts on labor protection.

To note the employee's right to refuse to perform work, the implementation of which is associated with a danger to his life or health or to the people who surround him and the natural environment.

The project developer draws attention to the presence of dangerous and harmful production factors in the workplace, their impact on the health of the employee, his right to benefits and compensation for working in such conditions.

7.2 Consideration of the factors with which the worker works

In this case, we will consider as a labor protection subject an airline employee who works with personnel who are studying, undergoing training or training courses for obtaining or improving qualifications.

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<i>Керівник</i>	<i>Белінський В.М.</i>					<i>75</i>	<i>94</i>
<i>Консульт.</i>	<i>Кажан К.І.</i>				173 «Авіоніка»		
<i>Н-контр.</i>	<i>Левкієвський В.В.</i>						
<i>Зав. каф.</i>	<i>Грищенко Ю.В.</i>						

His workplace can be like an office, where he can hold lectures, or hangars of the company, where the planes are parked, and inside them to show practical tasks visually.

During work, it is necessary to know the rules of application and safety techniques in the following areas of activity:

- 1 electrician;
- 2 repair tool;
- 3 non-working equipment;
- 4 behavior on the territory where crane and cargo works are carried out;
- 5 storages and use of various chemicals;

Among all the subject's activities, it is possible to single out factors that pose a threat to him:

- 1 electrical devices, lighting;
- 2 different lying or suspended loads;
- 3 heating devices;
- 4 metal fragments, shavings;
- 5 poisonous or caustic chemicals;
- 6 flammable substances.

7.3 Organization of the engineer's workplace in compliance with ergonomic standards

The workplace of the avionics engineer for multimedia devices and technologies, shown in the Figure 7.1, is located in a room with an area of 24 m², with air conditioning, three batteries, and 2 windows facing south. In winter, heating is mandatory. There are 4 workplaces in the room, each of which is

equipped with a personal computer, four sockets, radio-electronic devices, as well as a unit for checking the video of the tract, a copier and a telephone.

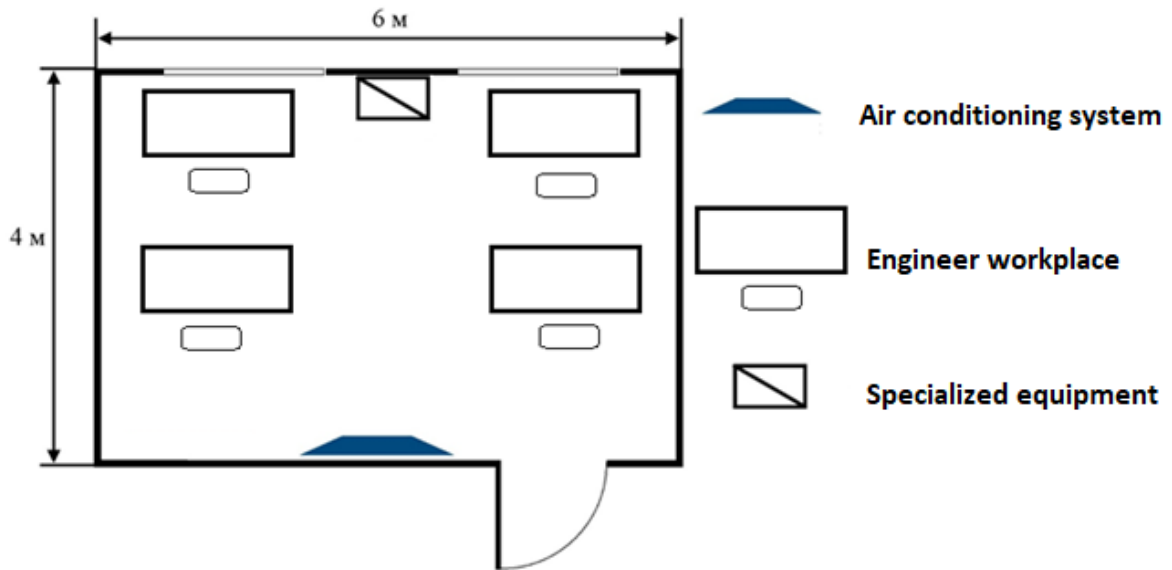


Fig. 7.1 The workplace of an avionics engineer

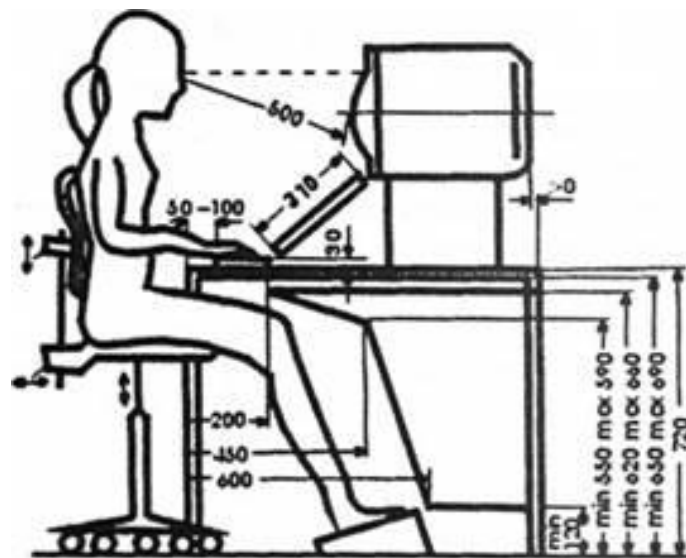


Fig. 7.2 Desktop and placement of the PC user.

According to the normative legal act dated April 25, 2018. for № 508/31960 general requirements for the arrangement of workplaces were put forward:

3. Safety requirements for workplaces of employees with screen devices

3.1 Workplaces of employees with screen devices should be designed and sized so that employees have space to change their working position and movements.

3.2 To ensure the safety and health protection of workers, all radiation from screen devices must be reduced to the maximum permissible level (the impact on a person of environmental factors - noise, vibration, pollutants, temperature, etc., which does not cause somatic or mental disorders, as well as changes state of health, work capacity, behavior that goes beyond the limits of adaptive reactions) from the point of view of safety and health protection of employees.

3.3 The organization of the workplace of an employee with screen devices must ensure compliance of all elements of the workplace and their location with ergonomic, anthropological, psychophysiological requirements, as well as the nature of the work performed.

3.4 The lighting of an employee's workplace with screen devices must create an appropriate contrast between the screen and the environment (taking into account the type of work) and meet the requirements of DSANPIN 3.3.2.007-98.

3.5 The microclimate of industrial premises with workplaces of employees with screen devices must be maintained at a constant level and meet the requirements of the sanitary norms of the microclimate of industrial premises DSN 3.3.6.042-99, approved by the resolution of the Chief State Sanitary Doctor of Ukraine dated December 1, 1999 No. 42 (hereinafter - DSN 3.3.6.042-99).

3.6 The desk or work surface should be of sufficient size and have a low-reflective surface, allowing flexibility in the placement of the screen, keyboard, documents and related equipment.

3.7 The work chair should be stable and allow the worker with screen devices to move easily and take a comfortable position.

The seat must be adjustable in height, the back of the seat - both in height and in inclination.

A step stool should be provided for those who need it for convenience.

4. Minimum safety requirements when working with screen devices

4.1 Every day before starting work, it is necessary to clean screen devices from dust and other impurities.

4.2 After finishing work, screen devices should be disconnected from the electrical network.

4.3 In the event of an emergency, it is necessary to immediately disconnect the screen device from the electrical network.

4.4 It is not allowed:

perform maintenance, repair and debugging of screen devices directly at the employee's workplace while working with screen devices;

disable protective devices, spontaneously carry out changes in the design and composition of screen devices or their technical adjustment;

to work with screen devices that have unusual signals, unstable screen image and other malfunctions during operation.

4.5 During the performance of operator-type work related to nerve and emotional stress, in the premises when working with screen devices, at consoles and control posts of technological processes and in other premises, optimal microclimate conditions must be observed in accordance with the requirements of DSN 3.3.6.042 -99.

5. Minimum security requirements for screen devices

5.1 Screen devices should not be a source of risk for workers.

5.2 All radiation, with the exception of the visible part of the electromagnetic spectrum, must be reduced to an insignificant level from the point of view of the safety and health of workers.

5.3 Symbols on screen devices must be clear and of the appropriate size. There must be the proper spacing between characters and character strings.

5.4 The image on the screen should be stable, without flickering or other types of instability.

5.5 The brightness and/or contrast of symbols should be easily adjustable by the worker when working with display devices, and should also quickly adapt to the surrounding conditions.

5.6 When choosing screens, preference should be given to screens that can easily and freely rotate and tilt according to the needs of the worker.

5.7 If necessary, a separate stand or adjustable table can be used to place the screen.

5.8 The screen should not glare or reflect light, so as not to cause discomfort to the employee while working with screen devices.

5.9 When choosing a keyboard, preference should be given to a keyboard that folds down and is autonomous (separated from the screen) so that the employee can choose a comfortable working position and avoid hand fatigue (hand and upper arm).

5.10 The surface of the keyboard should be matte to avoid reflections. The location of the keys and the keys themselves should make it easier to work with the keyboard. Key labeling should be sufficiently contrasting and legible.

5.11 The equipment included in the workstation should not emit

excessive heat, which may cause discomfort to employees when working with screen devices.

5.12 During the development, selection, ordering and modification of software, as well as during the development of tasks involving the use of equipment with screen devices, the employer must be guided by such software that corresponds to the tasks to be solved and is easy to use, and where necessarily - adapted to the level of knowledge and experience of the employee.

7.4 Ensuring fire and explosion safety in the facility under development

Fire safety is the state of the object, in which the possibility of the occurrence and development of fire and the influence of dangerous fire factors on people is excluded with a certain probability, as well as the protection of material values is ensured.

Fire safety of the facility must be ensured:

- fire prevention system;
- fire protection system;
- other organizational and technical measures.

To prevent the occurrence of a fire, the following measures must be taken:

1. Periodically check the reliability of soldering, especially plug connectors, the places of connection to external devices must ensure the necessary strength.

2. Installation of system elements must be performed in accordance with the requirements of regulatory documents. The cross-section of the installation wires must correspond to the current flowing through them,

according to the formula:

$$S_{np} = \frac{I_H}{\delta_H}$$

Where I_H – nominal current through the wire;

δ_H – permissible current density in the wire.

The permissible current density is determined depending on the conditions of laying the wire and ranges from 5 to 10A/mm².

3. Incorrect connection of system elements is excluded by the use of connectors with different structural characteristics.

4. To provide the engineering and technical personnel with fuses necessary for work.

In the event of a fire, the following measures must be taken:

- call the fire brigade;
- take measures to evacuate people who are in the fire zone;
- use fire-extinguishing means that have fire-extinguishing substances that do not conduct electric current (carbon dioxide, powder, inert gases). This is a fire extinguisher types BB-2, BB-3, BB-5, BBK-28, BBK-56.

Conclusion

According to the normative legal act, the workplace of an avionics engineer was created and analyzed. Attention was paid to a large number of factors that an employee may encounter during work. adjustments and recommendations have been made regarding behavior during emergencies and fire alarms

CHAPTER 8

ENVIRONMENTAL PROTECTION

8.1 Introduction

Environmental protection becomes a complex problem, which is determined by the complexity of the system that combines nature, society and production. Along with environmental protection tasks, it also solves socio-economic tasks - improving human living conditions, preserving his health. It is obvious that a written, scientifically based approach is necessary for environmental protection. Any technical process to one degree or another affects environmental protection, polluting it.

8.2 Modern devices as a source of pollution

Computers and smartphones are not capable of causing direct damage to the environment, because they do not produce any substances of a carcinogenic, poisonous or other harmful nature that affect the atmospheric air, water bodies, people, animals, vegetation or soil.

However, production causes indirect damage to the natural environment:

- high level of electricity consumption;
- electromagnetic radiation;
- acoustic pollution;
- soft X-ray radiation;

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- use of land resources for the production of computers.

The growth of the use of computers in various sectors of the national economy requires the most serious attitude to the issues related to the impact of computers on the living environment.

The elements of the circuit are mounted on printed circuit boards made of foiled fiberglass. During its processing, waste is inevitable: pieces of circuit boards, powder dust, which, falling into the soil, is stored for a long time. And the fumes formed during digestion have a harmful effect on the workers employed in this production and are released into the environment.

According to the source [1], after etching, the boards are washed with water and disinfected liquids (alcohol, gasoline, acetone). Due to the insufficient improvement of washing technologies, these substances can get into running water. All boards to increase electrical and fire safety are coated with E-4100 varnish (epoxy varnish). Evaporating varnish releases toxic substances into the atmosphere. Harmful vapors, gases, and compounds of tin and lead are emitted during the assembly of circuit boards and the soldering process. When installing wires, insulation and unused pieces of wires go to waste.

During operation of a computer, elements of its design emit heat (microcircuits, transistors, resistors heat up), as a result of which protective varnishes and paints heats up, creating toxic substances in the atmosphere in the form of volatile fractions. This is only a superficial analysis of one of the components of a computer

8.3 Analysis of the impact on the human body

Electromagnetic energy is used in radio, radio relay and space communications, radar, radio navigation, on television, in metallurgy and the metalworking industry for induction melting, welding, sawing of metals, in the

woodworking, textile, light and food industries, in radio spectroscopy, modern computing technology, medicine, etc.

In industrial premises, sources of electromagnetic radiation are unshielded working elements of high-frequency installations (inductors, capacitors, high-frequency transformers, feeder lines, capacitor banks, coils of oscillating circuits, etc.). During the operation of VHF and UHF transmitters at radio and television centers, the sources of electromagnetic radiation are high-frequency generators, antenna switches, devices for assembling the power of the electromagnetic field, communications (from the generator to the antenna device), and antennas.

The degree of exposure of workers depends on the number of transmitters placed in the room (there may be up to 20 in certain zones, at radio and television centers), their power, the degree of shielding, placement of individual units inside and outside the room.

For all types of communication, the source of electromagnetic radiation is radar stations, in particular, generators, feeder lines, antennas, individual units of energy of the electromagnetic field of microwave ranges.

Employees are exposed to microwave energy when adjusting, setting up and testing radar stations (Radar), in factories and repair shops. The main source of radiation in the plant's workshops is open antenna systems. During testing of radars at test sites or their operation in civil aviation, the working conditions of operators are more favorable, since most of the working time they are in screened cabins.

By production conditions, electromagnetic radiation is characterized by a variety of modes of generation and options for the actions of workers (radiation in the near zone, induction zone, general and local, which often acts together with other adverse environmental factors). Radiation can be isolated (from one EMF source), combined (from several EMF sources of the same frequency range), mixed (from several EMF sources of different frequency ranges) and combined (when another adverse factor acts simultaneously). EMF action can be continuous

or intermittent. The latter, in turn, can be periodic and aperiodic. An example of intermittent periodic action of EMF is radiation from radar antennas, which work in circular view or scanning mode. EMF can affect both the entire body of the worker (general exposure) and individual parts of it (local or local exposure).

8.4 Biological effect of the electromagnetic field on a person

According to the [2] there are two forms of negative impact on the human body of electromagnetic radiation in the radio frequency range - acute and chronic, which, in turn, is divided into three degrees: light, medium and severe. The chronic form is characterized by functional disorders of the nervous, cardiovascular and other systems of the body, manifested by asthenia syndrome, and vegetative disorders, mainly of the cardiovascular system.

Persons who are under the influence of chronic EMF radiation more often (1.9 times men and 1.5 times women) than those who are not exposed to radiation, complain of an unsatisfactory state of health, including headaches (1.5 times men and 1.3 times women), heart pain (1.8 times men and 1.5 times women), palpitations, general weakness, drowsiness, tinnitus, paresthesia, etc.

Electromagnetic radiation is a powerful physical stimulus. Different organisms have different sensitivity to natural and anthropogenic (artificial) EMFs: the nature and severity of the biological effect depend on EMF parameters and the level of organization of the biosystem. EMF millimeter waves mainly affect the receptor apparatus, longer waves affect the central nervous system.

Different organs and systems of the body absorb radio frequency radiation in different ways: their shape and linear dimensions, orientation relative to the EMF source are of significant importance. Primary changes in the functions of the central nervous system and related disorders cause biological effects at the level of organs and systems. Long-term exposure to high levels of electromagnetic radiation leads to overstrain of adaptive and compensatory mechanisms, significant

deviations in the functions of organs and systems, disturbances in metabolism and enzymatic activity, hypoxia, and organic changes. Since in the production environment, electromagnetic radiation acts, as a rule, in combination with other factors, its impact on the human body increases.

Protective and adaptive reactions that appear in humans under the influence of electromagnetic radiation are nonspecific. Most often, adaptive reactions are excitation of the central nervous system and an increase in the level of metabolism.

The effects of low-power radio frequency electromagnetic radiation on human biological tissues are divided into thermal and non-thermal. The thermal effect can be manifested in a person either by an increase in body temperature, or by selective (selective) heating of some of his organs, the thermoregulation which is difficult (gallbladder and urinary bladder, stomach, intestines, testicles, lenses, vitreous body, etc.). The effect of electromagnetic radiation on a biological object is detected when the radiation intensity is lower than its thermal threshold values, that is, non-thermal effects or a specific effect of radio waves are observed, which is determined by the informational aspect of electromagnetic radiation perceived by the organism and depends on the properties of the EMF source. It is obvious that information processes also play a certain role in the thermal effect of the electromagnetic field on the body. In addition, the action of electromagnetic radiation of low intensity leads to local heating - micro-heating.

Conventionally, the following mechanisms of biological action of EMF, which is described in [4] are distinguished:

- direct effect on tissues and organs, when the function of the central nervous system changes and the associated neurohumoral regulation;
- reflex changes in neurohumoral regulation;
- a combination of the main mechanisms of pathogenesis, the action of EMF with a predominant disturbance of metabolism, enzyme activity. The specific weight of

each of these mechanisms is determined by physical and biological changes in the human body.

In some cases, a person has pain in the heart, shortness of breath, palpitations, dizziness, increased sweating, the function of the thyroid gland increases, the menstrual cycle is disturbed in women, and sexual weakness is observed in men; the blood formula changes (the number of leukocytes and platelets decreases). One of the specific human lesions is a cataract, which can appear either immediately after exposure, or after 3-6 days, or develop gradually over several years. Cataracts are caused by the heating of the lens to a temperature beyond acceptable physiological limits. In addition to cataracts, corneal stroma damage and keratitis are possible.

Therefore, the impact of electromagnetic radiation has a systemic nature and requires appropriate systemic measures to protect against it.

8.5 Methods of minimizing the negative impact on people and the environment

To reduce the impact of the negative consequences of the production and use of electronic devices, it is necessary to understand their structure and be familiar with modern technologies, this is the only way to improve modern devices, not from a technical point of view, but from an environmental point of view.

Several main factors can be distinguished:

- electromagnetic pollution during use and production
- noise pollution during production
- chemical pollution during production and improper disposal
- territorial use of the land plot.

First, we will consider all the factors that arise during production.

To reduce electromagnetic radiation, it is necessary to carefully choose the place where the production facilities will be located. Choose a forested and, if possible, a mountainous area, which will absorb more radiation than desert plains and is far from cities and towns, this will level the residual radiation by scattering it. Also, modern methods of insulation, which absorb electromagnetic waves and prevent them from spreading, will help reduce radiation.

The reduction of radiation can also be ensured by turning off the devices and equipment in the production during non-working hours and turning them off immediately when there is no need for it.

Chemical reagents and solutions used during production must be properly disposed of and also used sparingly, modern cleaning and filtering equipment must be installed for cleaning fumes and vapors on smoke and ventilation installations. In no case do not pour them into the environment. Install sensors around the industrial zone to monitor the level of the chemical state of the groundwater and groundwater to detect and neutralize the source of pollution, if it is detected. Economical use of substances or their replacement with less harmful, more ecological ones will also help to reduce the risks of chemical pollution.

Territorial pollution has a greater effect on the very population of some animals and other organisms that exist in this environment. This may apply to species of chki that are in the Red Book of Ukraine [3], so this moment is also taken into account when choosing a place for the location of the future enterprise.

When using the devices, you should pay attention to their electromagnetic radiation and the chemical risks they represent.

According to the source [5] router emits quite powerful short electromagnetic waves of 2.4 - 5 GHz. The light from the computer monitor screen emits a rather bright unnatural light with a brightness of 300-500 lux, it can also be a source of noise pollution.

With excessive use and long-term exposure to these factors, headaches, migraines, nausea and fever, eye muscle spasm, dizziness and insomnia are possible.

To avoid such negative consequences, the following precautions should be observed when working with similar equipment:

- turn off devices when not needed, to avoid overloading the body during non-working hours.

- working hours should be organized as follows: 2 hours of work, 30 minutes break, end the working day after 8 hours of work.

- place the equipment in spacious, well-lit rooms that are not used for recreation, to minimize the load during non-working hours.

Chemical risks of pollution arise when the equipment is used incorrectly or when it is damaged or disposed of improperly.

To avoid chemical pollution, it is necessary:

- use work equipment as intended;
- observe safety techniques during operation and when storing equipment;
- in case of damage or breakdown of the equipment, it must be immediately taken to the point of processing of the corresponding waste.

The office equipment itself is disposed of separately from the batteries, therefore, during disposal, the batteries are dismantled from the device and transferred to the battery disposal point.

Conclusion

To reduce the damage caused by production to the environment, it is necessary to develop measures that ensure the neutralization of negative consequences, or, if possible, reduce the damage caused to the environment, namely:

1) introduction of new technologies that will make it possible to manufacture the design elements of the device with lower energy consumption and better technical characteristics.

2) the use of waste-free technologies, which, although they do not completely eliminate environmental pollution, but allow to significantly reduce it.

In this section, I considered the impact of harmful factors on the human body that occur during the production process of a digital devices, as well as the impact of other related equipment on the environment.

CONCLUSIONS

Explanatory notes contain instructions for the use of modern methods, devices and programs that are used nowadays for distance learning.

Their advantages are listed, the structure, scheme and functional features of a workplace for video conferencing specialized for the needs of aviation are developed and described.

The described jobs have a number of advantages, namely:

- Allows you to conduct classes online with the transfer of educational information and the possibility of broadcasting educational materials using cameras;
- It has high functionality compared to conventional training tools and allows you to visually demonstrate a separate image of the actions performed by the processor.
- The experiment proved that online classes can be conveniently and effectively conducted at a designed workplace, both in the classroom and on the plane.

Thanks to these advantages, the effectiveness of the training process increases and the functionality of the training of the airline personnel is significantly expanded.

REFERENCES

1. Ministry of Education and Science of Ukraine: ORGANIZATION OF
2. DISTANCE LEARNING IN SCHOOL METHODOLOGICAL RECOMMENDATIONS (2020)
3. Creative Economy October 2019 Journal of Creative Economy
4. САМОЛЕТ Ан-26 ИЛЛЮСТРИРОВАННЫЙ КАТАЛОГ ДЕТАЛЕЙ - ILLUSTRATED PARTS CATALOG
5. Владо Дамьяновски CCTV. Библия видеонаблюдения. Цифровые и сетевые технологии/Пер, с англ. - М.: ООО «Ай-Эс-Эс Пресс», 2006
6. С. А. Алексеев, В. В. Волхонский, А. В. Суханов ТЕЛЕВИЗИОННЫЕ
7. СИСТЕМЫ НАБЛЮДЕНИЯ ОСНОВЫ ПРОЕКТИРОВАНИЯ Учебное пособие, 2015
8. ДСТУ 7951:2015 Дизайн і ергономіка. Крісло оператора.
9. ДСТУ 7299:2013 Дизайн і Ергономіка
10. Покрокова інструкція щодо створення віртуального курсу дисциплін за допомогою платформи Google Classroom
11. В.С. Есентуков О СРАВНИТЕЛЬНЫХ ТЕСТАХ ВИДЕОКАМЕР Ч. 2
12. РЕКОМЕНДАЦІЇ щодо впровадження змішаного навчання у закладах фахової передвищої та вищої освіти
13. <https://www.moyo.ua/news/kak-pravilno-proverit-naushniki-i-mikrofon-5-sovetov.html>
14. <https://homester.info/design/rooms/idei-dlya-rabochego-mesta/11-idey-dlya-rabochego-mesta/>

15. ОРГАНІЗАЦІЯ ДИСТАНЦІЙНОГО НАВЧАННЯ В ШКОЛІ
МЕТОДИЧНІ РЕКОМЕНДАЦІЇ

16. <https://an-26.com/>

17. <https://rozetka.com.ua/>

18. https://support.google.com/edu/classroom/answer/6020279?hl=en&ref_topic=6020277

19. <https://www.microsoft.com/uk-ua/prystroi-dlia-navchannia>

20. https://studbooks.net/1212518/menedzhment/formy_metody_podgotovki_personala_organizatsii

21. <http://www.videoconferenceukraine.com/ru/vcsolutions/logitech/>

22. <https://osvitanova.com.ua/posts/4264-dodatky-i-platformy-dlia-zmishanoho-ta-dystantsiinoho-navchannia>

23. <https://myownconference.ru/blog/kamera-i-mikrofon/>

24. <https://www.ispring.ru/elearning-insights/metody-obucheniya-personala>

25. <https://staff-online.ru/rabochee-mesto-za-kompyuterom-35-lajfhakov-v-ego-organizacii/>

26. <https://trueconf.ru/videokonferenciya.html#001>

27. <https://ictech.com.ua/wp-content/uploads/2019/11/9.pdf>

28. <https://oppb.com.ua>

29. <https://redbook-ua.org/>

30. <https://conf.ztu.edu.ua>

31. <https://esu.com.ua>