National Technical University of Ukraine "Igor Sikorsky Kyiv Polytechnic Institute"

Department of space engineering

NAME OF THE COURSE

Safety of aircraft flights

Working program of the academic discipline (Syllabus)

Details of the academic discipline

Level of higher education	***First (undergraduate)***
Branch of knowledge	*13 Mechanical engineering*
Specialty	*134 Aviation and rocket and space technology*
Educational program	*Engineering of aviation and rocket-space systems*
Discipline status	*Selective*
Form of education	*Daytime*
Year of training, semester	*4th year, autumn semester*
Scope of the discipline	*4 ECTS credits, 120 hours (lectures – 36 hours, practical classes – 36 hours, independent work – 48 hours)*
Semester control/ control measures	*Test*
Lessons schedule	*In accordance with the WAP, lectures are presented in the schedule - 2 hours, 2 hours. - practical training: http://rozklad.kpi.ua*
Language of teaching	*Ukrainian*
Information about head of the course / teachers	Lecturer: candidate of technical sciences, senior researcher, Oleksandr Petrovych Lobunko *tel. +380660319202, e-mail: Lobunko_IAT@ukr.net* Practical classes: candidate of technical sciences, senior researcher, Oleksandr Petrovych Lobunko, *tel. +380660319202, e-mail: Lobunko_IAT@ukr.net*
Placement of the course	*A link to a remote resource (Moodle, Google classroom)*

Program of educational discipline

1. Description of the educational discipline, its purpose, subject of study and learning outcomes

When creating and operating aircraft, great attention is paid to calculating and ensuring their reliability, but it is not always possible to avoid failures, which leads to significant losses of resources, forces, and time. This is connected with the complication of the technique, the increasing complexity of design and technological tasks, special operating conditions. Therefore, the problem of creating reliable products of aviation and space technology is becoming more and more urgent.

The specifics of the activities of developers and mechanical engineers require in-depth knowledge of disciplines focused on the problems of ensuring the quality of the constructive execution of aircraft, their components and aggregates. One of these disciplines is "Aircraft Flight Safety".

The purpose of the educational discipline "Flight safety of aircraft" is the formation of students of higher education knowledge about theoretical and methodological issues of calculation, confirmation and standardization of quantitative indicators of the reliability of complex technical systems, organizational and technical aspects of solving the problem of ensuring the quality and reliability of aviation and space technology on at different stages of the life cycle.

The subject of the educational discipline "Aircraft flight safety" is the problems of aircraft flight safety, a modern conceptual, scientific and methodological apparatus. Methods of evaluating and

ensuring the safety of aircraft flights. Peculiarities of assessing the impact of aircraft failures devices (systems, main units), personnel errors, adverse external conditions on flight safety and measures to ensure and improve it. Basics of preventive work regarding the prevention of flight events and prerequisites for them. As a result of mastering the course, students of higher education should have a modern nomenclature and requirements for reliability indicators, methods of calculation, standardization, monitoring and ensuring the reliability and safety of the use of aerospace technology.

The program outcomes of training are mastering the skills of determining the reliability of aviation and space rocket systems, quantitative and qualitative assessment of the flight safety of aircraft during the life cycle, the ability to manage the risks of aviation and space activities. According to the results of training, the student of higher education acquires competence: the ability to develop the general design of aviation and rocket and space technology; the ability to calculate the reliability of elements of aviation and rocket and space technology; the ability to design and carry out tests of elements of aviation and rocket-space technology, its equipment, systems and subsystems.

2. 2. Prerequisites and postrequisites of the discipline (place in the structural and logical scheme of training according to the relevant educational program)

Prerequisites for the discipline "Aircraft Flight Safety" are the disciplines Mathematics, probability theory, mathematical statistics, physics, resistance of materials, theoretical mechanics, materials science.

Post-requisites of the discipline "Aircraft Flight Safety" are "Flight Dynamics", pre-diploma practice, diploma design, which will allow the student, and then the specialist, to professionally conduct engineering and technical research.

3. Content of the academic discipline

The theoretical course of the discipline consists of 36 academic hours and includes the following topics:

Topic 1. The problem of flight safety.
Topic 2. Theoretical foundations of flight safety and reliability.
Topic 3. Quantitative and qualitative assessment of flight safety.
Topic 4. Normative and informative provision of flight safety.
Topic 5. Provision of flights in special conditions, special cases in flight.
Topic 6. Standardization of airworthiness and certification of elements of aerospace systems.
Topic 7. The concept of flight safety management.
Topic 8. Technical means of ensuring flight safety.
Topic 9. Crew actions in emergency situations, organization of search and rescue operations.
Topic 10. Investigation of aviation events and incidents, data collection and analysis system
Topic 11. Prevention of aviation events.

Educational materials and resources

Basic literature:

1. Nechiporenko O. M. Fundamentals of the reliability of aircraft. - K.: NTUU "KPI", 2010. - 240 p.
2. Nabokina T.P., Kondratiev A.V., Parasyuk V.I. Basics of reliability of aircraft structures. - Kh.: Nat. aerospace University named after M.E. Zhukovsky "KHAI", 2021. - 112 p.
3. Kharchenko V.P., Alekseev O.M. Aviation risk management system. - K.: NAU, 2018. - 312 p.
4. Flight safety management manual. – ICAO, 2018. – 218 p.

Additional literature:

1. Міждержавний стандарт. Аналіз видів, наслідків і критичності відмов. – 13 с.
2. State standard. RELIABILITY OF RELIABILITY ANALYSIS TECHNIQUES. Substantive provisions.
3. Boyko A.P. Construction of aircraft / A.P. Boyko, O.V. Mamluk, Yu.M. Tereshchenko, V.M. Tsybenko; under the editorship Yu.M. Tereshchenko - K.: Higher education, 2001. - 383 p.
4. Romanovych M.I., Sytnyk Y.B. Flight safety management: methodological recommendations for independent work. – Kropyvnytskyi: FA NAU, 2021. – 20 p.

Electronic resources:

1. http://www.nkau.gov.ua.

2. http://www.nasa.gov.
3. http://www.esa.int.
4. https://avia.gov.ua.

Mandatory reading are the sections from the listed basic and additional literature that thematically correspond to the lecture material.

Educational content

4. Methods of mastering an educational discipline (educational component)

The discipline is designed for teaching during one semester. The lecture load consists of lectures - 36 ac. hours, practical classes - 36 ac. hours

Auditory classes are evenly distributed throughout the semester, which allows students of higher education to systematically organize and plan their work.

The purpose of lectures on the discipline "Aircraft flight safety" is to study the main theoretical provisions, achievements, methods and means of ensuring the reliability and safe use of aerospace systems.

The theoretical part consists of 11 logically related topics.

Approximate topics of lectures:

Lecture 1: Relevance of the problem of flight safety (topic 1).
Lecture 2: Theoretical foundations of flight safety and reliability (topic 2).
Lecture 3: Mathematical models of object reliability (topic 2).
Lecture 4: Reliability of objects in case of parametric failures (topic 2).
Lecture 5: Reliability of complex technical systems (topic 2).
Lecture 6: Quantitative and qualitative assessment of flight safety (topic 3).
Lecture 7: Normative and informative provision of flight safety (topic 4).
Lecture 8: Ensuring flights in special conditions (topic 5).
Lecture 9: Standardization of airworthiness (topic 6).
Lecture 10: Certification of aerospace system elements (topic 6).
Lecture 11: The ISAO concept of aviation accident prevention (Topic 7).
Lecture 12: Flight safety management mechanisms (topic 7).
Lecture 13: Technical means of ensuring flight safety (topic 8).
Lecture 14: Automated processing and express analysis of flight information (topic 8).
Lecture 15: Actions in emergency situations, organization of search and rescue operations (topic 9).
Lecture 16: Investigation of events and incidents, data collection and analysis system (topic 10).
Lecture 17: Preventive measures in operating units (topic 11).
Lecture 18: Preventive activities to prevent aviation events (topic 11).

The purpose of practical classes is to consolidate the knowledge gained at the lectures and to acquire professional skills in the practical use of the theoretical part of the educational content. Tasks of practical classes are performed using basic and additional literature, relevant electronic resources, lecture materials and are oriented towards independent understanding. The performance of the tasks of practical classes is preceded by theoretical preparation and the passing of knowledge control.

Approximate topics of practical classes:

Practical lesson 1. Analysis of system and non-system factors affecting flight safety, substantiation of preventive measures to identify dangerous factors (topic 1);

Practical lesson 2. Evaluation of reliability indicators of elements of aerospace systems (topic 2);

Practical lesson 3. Reliability modeling of elements of aerospace systems (topic 2);

Practical lesson 4. Evaluation of reliability indicators of elements of aerospace systems in case of parametric failures (topic 2);

Practical lesson 5. Evaluation of reliability indicators of elements of complex technical systems (topic 2);

Practical lesson 6. Quantitative and qualitative assessment of aircraft flight safety (topic 3);

Practical lesson 7. Analysis of the requirements of the main regulatory documents in the field of civil

aviation (topic 4);

Practical lesson 8. Preparation and execution of flights in special conditions, actions of the crew (topic 5);

Practical lesson 9. Analysis of the main requirements for airworthiness regulation of an aircraft (topic 6);

Practical lesson 10. ISAO requirements regarding the airworthiness of an aircraft (topic 6);

Practical lesson 11. Flight safety management approaches (topic 7);

Practical lesson 12. Aviation risk management system (topic 7);

Practical lesson 13. Familiarization with on-board means of collecting flight information, ground means of registration and processing of flight data (topic 8);

Practical lesson 14. Analysis of flight performance and operation of aviation equipment using objective control tools (topic 8);

Practical lesson 15. Analysis and justification of cases in which the aircraft crew can make a decision on forced landing (topic 9);

Practical lesson 16. Organization of the work of the commission for the investigation of aviation events and incidents (topic 10);

Practical lesson 17. Development of measures to prevent aviation events and incidents (topic 11);

Practical lesson 18. Credit.

The calendar plan for the organization of the educational process is presented in Table 1.

Table 1.

№ Week	№ Lectures	№ Practical lesson
1	Lecture 1	Practical lesson 1
2	Lecture 2	Practical lesson 2
3	Lecture 3	Practical lesson 3
4	Lecture 4	Practical lesson 4
5	Lecture 5	Practical lesson 5
6	Lecture 6	Practical lesson 6
7	Lecture 7	Practical lesson 7
8	Lecture 8	Practical lesson 8
9	Lecture 9	Practical lesson 9
10	Lecture 10	Practical lesson 10
11	Lecture 11	Practical lesson 11
12	Lecture 12	Practical lesson 12
13	Lecture 13	Practical lesson 13
14	Lecture 14	Practical lesson 14
15	Lecture 15	Practical lesson 15
16	Lecture 16	Practical lesson 16
17	Lecture 17	Practical lesson 17
18	Lecture 18	Test

5. Independent work of the student

The volume of independent work during the semester is 48 academic hours. The structure of independent work is as follows.

Preparation for classroom lectures (12 academic hours).

Preparation and implementation of tasks of practical work (12 academic hours).

Performance of control work (12 academic hours).

Preparation for the test (12 academic hours)

Policy and control

6. Policy of academic discipline (educational component)

Attending lectures and practical classes is mandatory and is carried out according to the approved schedule or according to the individual plan of the student of higher education. In case of missing lectures, the student works on its electronic version and explains the main provisions in a short essay. Missed practical classes are made up at the end of the semester according to a separate approved schedule.

Complex moments of the topics presented at the lectures can be entrusted to the students of higher education to prepare short reports for discussions in order to increase the activity of the listeners.

Tasks of practical work are given to each student individually, defended at the next scheduled lesson. Tasks are drawn up in the form of reports.

The control work is issued individually to each individual and is defended in the form of a written work containing the necessary calculation and analytical and graphic materials (drawings, graphs, references to normative and scientific and technical literature).

In practical classes, educational materials of the relevant subject are demonstrated, including those prepared with the participation of students of higher education and with their support and comments.

Questions that are debatable or can be solved by various methods, methods, and technologies are subject to discussion in classes. Each of the options for solving the problem is prepared by the relevant speaker, and the best option is determined in the process of group discussion.

The following rules of incentive and penalty points are used.

5 points are awarded for the work on improving the didactic material of the discipline, 3 points are awarded for the preparation and support of the educational video. 3 points are awarded for the preparation of a mini report on a variable and discussion question, for a creative approach to work, active participation in the discussion of topics, independent search for topics: +1...4 points.

2 points will be deducted for absence from classes, untimely completion of practical tasks without valid reasons. In the case of detection of plagiarism during the performance of the control work, or non-independent performance of tasks of practical work, their results are canceled.

7. 7. Types of control and rating system for evaluating learning outcomes (PCO)

The student's rating in the discipline consists of the points he receives for the following:

- performance of tasks and answers in classes;
- performance of control work;
- answers to the test.

System of rating (weighted) points and evaluation criteria.

1. Practical works.

Weight score – 2.

The maximum number of points is equal to 2 x 18 = 36 points.

Evaluation criteria:

complete completion of the task – 2;

performance, but theoretical knowledge is insufficient – 1;

not prepared – 0.

2. Control work.

Weight score – 12.

The maximum number of points is equal to 12 points x 1 = 12 points.

Evaluation criteria:

complete completion of the task – 12;

incomplete completion of the task – 1...11;

unsatisfactory performance – 0.

Penalty and incentive points:

creative approach to work, active participation in discussion of topics, search for topics: +1...4 points;

absence from class without a good reason: – 2 points.

The maximum number of incentive and penalty points is 4.

Calculation of the rating scale (RC):

the sum of weighted points of control measures during the semester is:

RC = 36 + 12 = 48 points.

A necessary condition for admission to the credit is the timely completion of the tasks of all practical work, the Control work and the provision of relevant reporting materials to the teacher

3. Settlement.

The credit component of the scale is equal to 52% of R, namely 52 points, and consists of a theoretical part containing two questions on different topics.

For each question, subject to fluency in the material, answers to all additional questions – up to 26 points

fairly confident mastery of the material, incomplete answers to additional questions – up to 20 points;

uncertain answer to the main question, no answer to additional questions – up to 10 points;

does not have an answer to the main question – 0 points.

Thus, the rating scale of the discipline is:

$R = R_C + R_E = 48 + 52 = 100$ points.

Conditions for a positive intermediate certification in the semester.

In order to receive "credited" from the first intermediate certification (8th week), the student will have at least 12 points (provided that at the beginning of the 8th week, according to the control activities calendar, the "ideal" student must receive 20 points).

To receive "passed" from the second intermediate certification (week 14)), the student will have at least 24 points (provided that at the beginning of week 14, according to the calendar plan of control activities, the "ideal" student should receive 40 points).

Table of correspondence of rating points to grades on the university scale:

Scores	Rating
100-95	Perfectly
94-85	Very good
84-75	Good
74-65	Satisfactorily
64-60	Enough
Less 60	Unsatisfactorily
Admission conditions not met	Not allowed

8. Additional information on the discipline (educational component)

The list of questions submitted for semester control.

1. Theoretical foundations of flight safety and reliability.
2. System reliability function and methods of its composition.
3. Reliability of systems with redundancy.
4. The method of structural and logical schemes.
5. Methods of determining and analyzing quantitative indicators of reliability.
6. Statistical control of the distribution parameters of a random variable.
7. Methods of confirming given quantitative indicators of reliability.
8. Mathematical models of object reliability.
9. Reliability of objects in case of parametric failures.
10. Reliability of complex technical systems.
11. Quantitative and qualitative assessment of flight safety.
12. Normative and informative provision of flight safety.
13. Provision of flights under special conditions.

14. Standardization of airworthiness.
15. Certification of aerospace system elements.
16. Concept of ICAO regarding prevention of aviation events.
17. Flight safety management mechanisms.
18. Technical means of ensuring flight safety.
19. Automated processing and express analysis of flight information.
20. Actions in emergency situations, organization of search and rescue operations.
21. Investigation of events and incidents, data collection and analysis system.
22. Types and content of preventive activities regarding the prevention of aviation events.

The discipline "Aircraft flight safety" is constantly updated and improved. The modern stage is characterized by the possibility of active creative influence of the participants of the educational process on the further development of the discipline, appropriate educational and methodological support, scientific and experimental base. Such conditions provide for the use of modern scientific achievements, works, dissertations, monographs, regulatory documents and other new sources of information for mastering the discipline, and not only the proposed literature and electronic information resources.

Working program of the academic discipline (syllabus):

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Agreed by the Methodical Commission of the Educational and Scientific Institute of Aerospace Technologies (protocol № 6 22.06.2023).