İnstrument engineering (INEN) program, “İnstrument engineering” department

Course Unit Title	Fundamentals of interchangeability
Course Unit Code	VTES-B05-2
Type of Course Unit	Compulsory
Level of Course Unit	4th year İEP program
National Credits	0
Number of ECTS Credits Allocated	7
Theoretical (hour/week)	2
Practice (hour/week)	2
Laboratory (hour/week)	2
Year of Study	4
Semester when the course unit is delivered	7
Course Coordinator	Arzu E.İbrahimova
Name of Lecturer (s)	Arzu E.İbrahimova
Name of Assistant (s)	-
Mode of Delivery	Face to Face, Seminar.
Language of Instruction	English
Prerequisites	-
Recommended Optional Program Components	-

Course description:

The concept of interchangeability and its types. Interchangeability of products. The main provisions of interchangeability by geometric parameters. Dimensions and maximum deviations. Tolerances and landings. Ensuring the functional interchangeability of products The international system of tolerances and landings, the general principles of its construction, designations. Unit of tolerance, size intervals, deviations, principles of preference.

The essence of standardization. Basic terms and definitions in the field of standardization, principles of standardization. The category of standards. Development and approval of national standards, all-Russian classifiers of technical, economic and social information, standards of organizations, codes of rules. Types of technical control. Standardization of parameters of roughness of undulation, norms of accuracy of the shape and location of surfaces.

The concept of metrology. Theoretical foundations of metrology, basic concepts related to measurement objects and measuring instruments. Brief information from the history of the development of metrology. Classification of measurements. Physical units. Measurement errors. Measuring instruments and their errors. Measuring instruments, metrological characteristics and their rationing. State regulation in the field of ensuring the uniformity of measurements. Organizational bases for ensuring the uniformity of measurements. State metrological control and supervision..

Objectives of the Course:

The discipline "Fundamentals of Interchangeability" is studied with the aim of forming ideological concepts and principles in the field of interchangeability, standardization and technical measurements, acquiring knowledge and skills for practical application and developing skills in solving issues of practical use of reference technical literature in the production, repair and operation of equipment

Learning Outcomes

At the end of the course the student will be able to		Assessment
1	To understand clearly the concepts and effects of interchangeability, standardization and measurement technology.	1
2	To familiar with the basic content of every tolerance studied in this course, to know exactly the basic terms.	1,2,3
3	To analyse fit properties and fit type during read an assembly drawing and to draw the size tolerance zone figure	1
4	During read a detail drawing (single part drawing), to know exactly the precision requirements about size, form, orientation, location, runout and surface texture. To be able to calculate the limits of size , to describe the form, orientation, location requirements for every feature, to draw the dynamic tolerance zone figure of tolerance principle.	1
5	During draw a engineer drawing (assembly drawing and detail drawing), to indicate the precision requirements on the drawing correctly according to the standards	1,2

Assessment Methods: 1. Final Exam, 2. Presentation, 3. Midterm exam

Course's Contribution to Program

		CL
1	Ability to understand a comprehensive interchangeability principles, which are crucial in manufacturing, engineering, and product design.	5
2	Students will learn how standardized parts can be used across different systems to ensure compatibility and reduce production costs.	4
3	Ability to apply theoretical knowledge to practical problems, enabling them to solve challenges related to precision, tolerance, and functionality in various industries such as automotive, aerospace, and etc.	4
4	Students will learn importance of technical competence by teaching the use of industry standards like ISO and ANSI for part interchangeability. It emphasizes the importance of precision engineering and helps students acquire the skills necessary for designing systems where parts can be substituted without affecting performance.	4
5	Students will learn how interchangeability leads to more sustainable practices by reducing waste and resource consumption. Students will learn how standardization and the efficient use of interchangeable parts contribute to lean manufacturing processes.	3
6	Students will learn the importance of precision and dimensional tolerance **in** interchangeable parts, a critical area in fields like aerospace, automotive, electronics**, and** medical devices**.** The course offers hands-on learning experiences where students calculate and apply tolerances, a vital skill for ensuring quality control and product safety.	4
7	Ability to use the language skills to exchange and obtain some knowledge gained from the foreign sources.	1
8	Ability to analyze the problem, to identify the basic requirements, to justify the idea and	3

	critically evaluate the results and to compare them.	
9	Students will learn how Interchangeability is crucial for ensuring product reliability and ease of maintenance. The course equips students with skills in quality assurance practices, ensuring that products meet strict performance and safety standards. This contribution supports broader program goals related to reliability engineering	3
10	Ability to work productively in multidisciplinary groups, especially in projects requiring engineering skills and to carry out all work in accordance with relevant laws, regulations, standards, methods and guidelines.	2

CL: Contribution Level (1: Very Low, 2: Low, 3: Moderate, 4: High, 5: Very High)

Course Contents

Week	Chapter	Topics	Exam
1	[1]: Chapter 2, s: 4-40	Interchangeability as method of quality assurance of product at the design stage	
2	[1]: Chapter 1, s: 26-53	Interchangeability as a method of standardization	
3	[1]: Chapter 3, s:68-78	Basic concepts and definitions. Types of interchangeability System of tolerances and fits. Basic definitions	
4	[1]: Chapter 1, s:14-26	Tolerances and fits of spline connections.	
5	[1]: Chapter 3, s:84-110	Interchangeability of threaded connections	
6	[1]: Chapter 3, s:110-133	Tolerances and fits of rolling and sliding bearings.	
7	[1]: Chapter 3, s:133-139	Accuracy. And accuracy classes of rolling bearings	Midterm
8	[1]: Chapter 4, s:140-167	Standardization of keyed and spline connections. Fitting tolerances of parallel keys.	
9	[1]: Chapter 5, s:192-239	Transitional landings. Deviations and tolerances of the shape of flat surfaces.	
10	[1]: Chapter 5, s:208-222	Waviness and surface roughness.	
11	[2]: Chapter 23, s:737-770	Roughness parameters.	
12	[1]: Chapter 23, s:1056-1071	Methods for calculating dimensional chains	
13	[1]: Chapter 6, s:248-261	Method for calculating dimensional chains for maximum-minimum.	
14	[2]: Chapter	Basic concepts and definitions. Types of interchangeability.	

	17, s:530-572	Unified creation principles of tolerances and fits systems according to ISO and ANSI standards of details and standard mechanical engineering products	
15	[1]: Chapter 9, s:372-413	Problem of the equipment quality. Quality of product at the design stage	
			Final

Recommended Sources

TEXTBOOK(S)

1. G.S. Zhetessova, A.SH. Zhunussova, G.B. Tattimbetova. Basics of Interchangeability: Textbook. Second Edition. Expaned. Translated into English. – Karaganda, 2016. – 278 p

Supplementary Course Material:

2. Golygin N. H., Pedy S. E., Druzhinin P. V. Fundamentals of interchangeability: A textbook for universities. - Moscow: Publishing house of MIIGAiK, 2020. - 316 p.: il.
3. 2. Interchangeability, standardization and technical measurements: textbook. Edited by S. M. Gorbatyuk. Textbook for universities. NUST MISiS. 2019 – - 328 p.
4. Metrology, standardization and certification: textbook / I. A. Ivanov, S. V. Urushev, D. P. Kononov [et al.]; edited by I. A. Ivanov, S. V. Urushev. - St. Petersburg: Lan, 2019 — - 356 p.

Assessment

Attendance	0%	At least 75% class attendance is compulsory
Presentation	20%	
Seminar	0%	
Midterm Exam	30%	Written Exam
Final Exam	50%	Written-Oral Exam
Total	100%	

Assessment Criteria

Final grades are determined according to the Academic Regulations of Azerbaijan State Oil and Industry University for Undergraduate Studies

Course Policies

- Attendance of the course is mandatory.
- Late assignments will not be accepted unless an agreement is reached with the lecturer.
- Students cannot use calculators during the exam.
- Cheating and plagiarism will not be tolerated. Cheating will be penalized according to the Azerbaijan State Oil and Industrial University General Student Discipline Regulations

ECTS allocated based on Student Workload

Activities	Number	Duration (hour)	Total Workload(hour)
Course duration in class (including midterm)	**15**	**6**	**90**

Presentation	1	10	10
Tutorials	10	1	10
Preparation for midterm exam	1	10	10
Final Examination	1	3	3
Preparation for final exam	1	28	27
Self-study	12	5	60
Total Workload			**210**
Total Workload/30(h)			**210/30**
ECTS Credit of the Course			**7**