Bachelor program,
Instrumentation Engineering (INEN) program, "General and Applied Mathematics" department

Course Unit Title	Calculus 1
Course Unit Code	VTSS-B02.1
Type of Course Unit	Compulsory
Level of Course Unit	1 st year INEN program
National Credits	0
Number of ECTS Credits Allocated	4
Theoretical (hour/week)	2
Practice (hour/week)	2
Laboratory (hour/week)	0
Year of Study	1
Semester when the course unit is delivered	2
Course Coordinator	Ruqiyya Azizova
Name of Lecturer (s)	Ruqiyya Azizova
Name of Assistant (s)	-
Mode of Delivery	Face to Face
Language of Instruction	English
Prerequisites	-
Recommended Optional Programme Components	-

Course description:

This course covers the fundamental principles of calculus, including limits, derivatives, and integrals of single-variable functions. It emphasizes understanding rates of change, area under curves, and applications in real-world problems across science, engineering, and economics.

Objectives of the Course:

After attending the module, students are able to understand the concept of limits and continuity, apply differentiation techniques to solve problems involving rates of change, use integration to find areas, volumes, and solve accumulation problems, analyze and interpret the behavior of functions graphically and analytically, apply calculus concepts to practical problems in science and engineering.

Learning Outcomes

At the end of the course the student will be able to		Assessment
1.	Apply remarkable limits when calculating limits.	1,2,3
2.	Calculate derivatives of functions given in implicit and parametric form.	1,2,3
3.	Apply the Lopital rule when calculating limits.	1,2,3
4.	Be able to calculate integrals by various methods.	1,2,3

Assessment Methods: 1: Final Exam, 2: Midterm exam, 3: Individual work, 4: Seminar

Course's Contribution to Program

		CL
1	Ability to develop as a specialist in the field of fundamental sciences and apply basic knowledge.	4
2	Ability to analyze and model functional and structural schemes of various purpose devices and systems.	4
3	Ability to use modern methods and tools, creation, selection, and application of engineering and information technology tools and modern devices and equipment.	4
4	The ability to use the strategy of team cooperation in the exchange of information, knowledge, and experience to achieve the set goal.	4
5	As a result of training, the ability to use engineering knowledge, mathematical models, and basic concepts of physics and chemistry in production and technological processes, automation, measurement, and control systems.	4
6	The ability to use modern software to process technical documents of devices, design their structures, and algorithmize processes.	4
7	The ability to apply artificial intelligence to improve the quality characteristics of measurement and control systems.	4
8	The ability to process information acquisition, processing, and transmission processes based on schematic and programmable logical integrated circuits.	4
9	Ability to use knowledge to improve quality indicators and environmental safety of production	4

	processes.	
10	Self-development ability to apply theoretical and experimental knowledge in solving modern engineering problems.	4

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

Course Contents

Week	Chapter	Topics	Exam
1	[4], Ch 2, pp. 78-90	**Numerical sequences. Limit of a sequence.** Bounded and unbounded sequences. Convergent and divergent sequences. Properties of convergent sequence associated with inequalities. Infinitesimal and infinitely large sequences. Properties of convergent sequence associated with equalities. Monotone sequences. Monotone convergence. Weirstrass theorem. Number *e* and natural logarithm	
2	[4], Ch 2, pp. 78-90	**Subsequences.** Bolzano-Weirstrass theorem. Fundamental sequences. Cauchy`s test on the equivalence of fundamental and convergent sequences. Partial limit, upper and lower limits of sequences	
3	[1], Ch 2, pp. 83-113	**Limit of a function.** Definition Limit of a function at the point. Properties of limit of functions. One-sided limits. Remarkable limits. Infinitesimal and infinitely large functions. Local comparison of functions, Symbols “O”, “o”, “~”and its properties	
4	[1], Ch 2, pp. 115-125	**Continuity of function at the point and on the set.** One-sided (left and right) continuity of function at the point. Properties of continuous functions at the point. Continuity of basic elementary function. Points of discontinuity of a function and its classification	
5	[1], Ch 2, pp. 140-165	**Derivative of a function.** Definition of derivative of a function at the point, one-sided (left and right) derivative of a function. Continuity of function at the point having a finite derivative at this point. Differentiable function at a point. Differential of function at the point. Differentiability criterion. Basic differentiation rules. Differential of an algebraic sum, product and quotient of differentiable functions.	
6	[1], Ch 4, pp. 287-293	**Basic theorems of differential calculus.** Theorems of Fermat, Rolle, Lagrange and Cauchy.	
7	[1], Ch 4, pp. 304-314	**Derivatives of higher order.** L`Hospital- Bernoulli` rule for calculation indeterminate form of the $\frac{0}{0}, \frac{\infty}{\infty}$ $n-$ order derivative formulas for some basic elementary functions. $n-$ order derivative of an algebraic sum, product of two functions. Leibniz formula. Differentials of higher orders	
8			Midterm
9	[1], Ch 3, pp. 258-259	**Taylor`s formula and Maclaurin`s formula.** Remainder term in Peano`s form. Expanding some elementary functions by Maclaurin`s formula.	
10	[1], Ch 4, pp. 276-287, 294.	**Extrema of functions.** Necessary and sufficient conditions, using derivatives of first and higher order. The greatest and the least value of a function on the set.	
11	[1], Ch 4, pp. 316-320	**Asymptotes of the function graph.** Asymptotic conditions.	
12	[1], Ch 5 pp. 402-403, 412-416, Ch 7, pp. 472-500	**Antiderivatives.** Indefinite integral. Integration by parts. Integration by change of variable. Integration of rational functions. Integration of trigonometric functions.	
13	[1], Ch 5, pp. 378-39	**Riemann` definite integral**. Necessary conditions for its existence. Darboux sums and their properties. Darboux criterion for the integrability of a function. Properties of definite integrals	
14	[1], Ch 5, pp. 392-400, 416-	**Definite Integral with Variable Limits and their properties.** Newton-Leibniz formula. Integration by parts, Change of variable in the	

	418,	definite integral.	
15	[1], Ch 7, pp. 527-533	**Improper Integrals, their properties.** Cauchy's Test for Convergence of Improper Integrals. Improper Integrals of nonnegative functions. Absolute and conditional convergence of Improper Integrals.	
16			Final exam

Recommended Sources

TEXTBOOK(S)

1. James Stewart. Calculus. Early Transcendentals. McMaster University and University of Toronto. Printed in USA. 2014.
2. Thomas`Calculus. George B. Thomas. Massachusetts Institute of Technology. 2004
3. Calculus. Ron Larson. Bruce Edwards. 2014
4. A.F.Bermant, I.G.Aramonovich. Mathematical Analysis. Mir Publishers. Moscow. 2005
5. G.M.Azimova. Lecture in Higher Mathematics for Engineers. Part 1. Baku. 2017.

Assessment

Attendance	0%	Less than 75% class attendance results in NA grade
Individual work	20%	
Lab. works	0%	
Course work	0%	
Quiz	10%	
Midterm Exam	20%	Written Exam
Final Exam	50%	Written Exam
Total	100%	

Assessment Criteria

Final grades are determined according to the Academic Regulations of Azerbaijan State Oil and İndustry University for undergraduate studies

Course Policies

1. Attendance of the course is mandatory.
2. Material presented in the lecture as well as assigned readings will be included in testing.
3. Late assignments will not be accepted unless an agreement is reached with the lecturer.
4. Cheating and plagiarism will not be tolerated.
5. 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	14	4	56
Individual work	9	4	36
Self-study	10	1	10
Tutorials	3	4	12
Midterm Examination	1	3	3
Preparation for midterm exam	1	15	15
Final Examination	1	3	3
Preparation for final exam	1	12	12
Total Workload			147
Total Workload/30(h)			4.9
ECTS Credit of the Course			4