Identification	**Subject (code, title, credits)**	Numerical Analysis, MATH 330, 6 ECTS
	Department	Mathematics
	Program (undergraduate, graduate)	Undergraduate
	Term	Spring, 2022
	Instructor	Vusal Osmanov
	E-mail:	VusalOsmanov@khazar.org
	Phone:	(+99470) 333 33 48
	Classroom/hours	Friday: 08:30-10:00, 10:10-11:40
Prerequisites	MATH 102	
Language	English	
Compulsory/ Elective	Required	
Required textbooks and course materials	***Corse Textbooks:*** 1. R.L. Burden and J. D. Faires, *Numerical Analysis,* 10th ed., 2016, Cengage Learning, Boston, USA, 895 p. 2. K. Atkinson and W. Han, *Elementary Numerical Analysis,* 3rd ed., John Wiley, New York, 2003. ***Supplementary books*** 1. J.C. Butcher, *Numerical Methods for Ordinary Differential Equations,* 2nd ed., John Wiley, New York, 2008. 2. K. Atkinson and W. Han, *Theoretical Numerical Analysis,* Springer, 2001. 3. R. Kress, *Numerical Analysis,* Springer, New York, 1998.	
Course website		
Course outline	The course of Numerical Analysis is an essential at School of Science and Engineering of Khazar University. This course is offered to undergraduates and introduces students to the formulation, methodology, and techniques for numerical solution of some mathematical problems. Topics covered include: • Computing the values of exponential, logarithmic, and trigonometric functions; • Computing the approximate values of square and cube root functions; • Finite differences, divided differences of various orders, and their properties; • Interpolational polynomials for equidistant and unequidistant nodes; • Error estimation of interpolational formulas; • Numerical differentiation formulas; • Newton-Cotes formula and its special cases; • Approximation solution of system of linear algebraic equations; • Numerical methods for non-linear algebraic equations; • Euler's and Runge-Kutta (R-K) methods for the numerical solution of the Cauchy problem for ODEs; • Finite difference method for second order linear differential equations; • Numerical methods for integral equations.	
Course objectives	Numerical methods are used frequently in all areas of science, such as computer science, mechanichs, physics, geology, fluid dynamics, meteorology and financial risk management. Moreover, techniques of numerical analysis play an important role in mathematical research on the finding the required values from the tabulated function, approximating solutions of linear and non-linear algebraic equations (including system), differential equations, stochastics, optimization, etc.	

<table>
<tr><td>Learning outcomes</td><td colspan="3">Upon successful completion of the course, the students will be able to:
• Understand the theoretical and practical aspects of the numerical methods;
• Solve the selected problems, both manually and by writing computer programs;
• Find the approximate values of exponentioal, logarithmic, and trigonometric functions;
• Apply the interpolation methods to find intermediate values in given graphical and/or tabulated data;
• Compute the integrals by the numerical methods;
• Understand the numerical techniques to find the roots of non-linear equations and solution of system of linear equations;
• Be able to use appropriate numerical methods to solve ordinary differential equations;
• Analyse the errors obtained in the numerical solution of problems;
• Compare the various algorithms with respect to the accuracy and efficiency of the solution;
• Implement numerical methods in computer software.</td></tr>
<tr><td rowspan="7">Teaching methods</td><td colspan="2">Lecture</td><td>x</td></tr>
<tr><td colspan="2">Group discussion</td><td>x</td></tr>
<tr><td colspan="2">Experiential exercise</td><td>x</td></tr>
<tr><td colspan="2">Simulation</td><td></td></tr>
<tr><td colspan="2">Case analysis</td><td></td></tr>
<tr><td colspan="2">Course paper</td><td>x</td></tr>
<tr><td colspan="2">Others</td><td></td></tr>
<tr><td rowspan="7">Evaluation</td><td>Methods</td><td>Date/deadlines</td><td>Percentage (%)</td></tr>
<tr><td>Midterm Exam</td><td></td><td>30</td></tr>
<tr><td>Quizzes</td><td></td><td>20 (2 quizzes)</td></tr>
<tr><td>Activity</td><td></td><td>5</td></tr>
<tr><td>Attendance</td><td></td><td>5</td></tr>
<tr><td>Final Exam</td><td></td><td>40</td></tr>
<tr><td>Total</td><td></td><td>100</td></tr>
<tr><td>Policy</td><td colspan="3">Preparation for class
The structure of this course makes your individual study and preparation outside the class extremely important. The lecture material will focus on the major points introduced in the text. Reading the assigned chapters and having some familiarity with them before class will greatly assist your understanding of the lecture. After the lecture, you should study your notes and work relevant problems and cases from the end of the chapter and sample exam questions.
Throughout the semester we will also have a large number of review sessions. These review sessions will take place during the regularly scheduled class periods.
Quizzes and examinations
Quizzes may be given unannounced throughout the term. There will be no make-up quizzes.
No make-up exams. If students miss an exam, a zero score will be assigned to the missed exam.
Withdrawal (pass/fail)
This course strictly follows grading policy of the School of Engineering and Applied Science. Thus, a student is normally expected to achieve a mark of at least 60% to pass. In case of failure, he/she will be required to repeat the course the following term or year.
Cheating/plagiarism
Cheating or other plagiarism during the Quizzes, Mid-term and Final Examinations will lead to paper cancellation. In this case, the student will automatically get zero (0), without any considerations.
Professional behavior guidelines
The students shall behave in the way to create favorable academic and professional environment during the class hours. Unauthorized discussions and unethical behavior are strictly prohibited.
Ethic
Use of any electronic devices is prohibited in the classroom. All devices should be turned</td></tr>
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	off before entering class. This is a university policy and violators will be reprimanded accordingly! Students should not arrive in late to class!	

Tentative Schedule

Week	Date/Day (tentative)	Topics	Textbook/ Assignments
1	11.02.22 11.02.22	Computing the values of exponential and logarithmic functions. Computing the values of square and cube root functions.	Chapter 1.1,1.2 [Burden and Faires, Numerical analysis]
2	18.02.22 18.02.22	Finding the numerical values of trigonometric functions.Interpolation.	Chapter 1.3, 1.4 [Burden and Faires, Numerical analysis]
3	25.02.22 25.02.22	Finding the numerical values of trigonometric functions.Interpolation.	Chapter 1.3, 1.4 [Burden and Faires, Numerical analysis]
4	03.03.22 03.03.22	Interpolation.Lagrange's interpolation formula and its error estimation. Numerical differentiation formulas.	Chapter 4.1.1, 4.1.2 [K.Atkinson and W.Han, Elementary Numerical analysis]
5	10.03.22 10.03.22	Finite and Divided differences of various orders. Newton's interpolation formulas. Newton's Forward and Backward difference formulas.	Chapter 4.1.4, 4.1.6 [K.Atkinson and W.Han, Elementary Numerical analysis]
6	17.03.22 17.03.22	Splines.Cubic spline	Chapter 4.3.1, 4.3.2 [K.Atkinson and W.Han, Elementary Numerical analysis]
7	24.03.22 24.03.22	Novruz Holiday	
8	31.03.22 31.03.22	Numerical integration. Closed Newton-Cotes formulas. Open Newton-Cotes formulas. Composite numerical integration. Round-off error stability.	Chapter 4.3,4.4 [Burden and Faires, Numerical analysis] **Quiz (10 pts)**
9	07.04.22 07.04.22	**MIDTERM EXAM** The Gauss-Siedel and Jacobi iterative techniques for system of linear algebraic equations. General iteration methods.	Chapter 7.3,7.4 [Burden and Faires, Numerical analysis]
10	14.04.22 14.04.22	LU factorization method for system of linear algebraic equations.	Chapter 6.4.1, 6.4.2 [K.Atkinson and W.Han, Elementary Numerical analysis]
11	21.04.22 21.04.22	The simple iteration and halving methods for numerical solution of non-linear algebraic equations.	Chapter 6.6.1, 6.6.2 [K.Atkinson and W.Han, Elementary Numerical analysis]
12	28.04.22 28.04.22	The secant and tangent methods for numerical solution of non-linear algebraic equations.	Chapter 7.3.1, 7.3.2 [K.Atkinson and W.Han, Elementary Numerical analysis]
13	05.05.22 05.05.22	Euler's method for the numerical solution of the Cauchy problem for ODEs.	Chapter 8.1.2, 8.2 [K.Atkinson and

			W.Han, Elementary Numerical analysis]
14	12.05.22 12.05.22	Runge-Kutta (R-K) method for the numerical solution of the Cauchy problem for ODEs.	Chapter 8.5.1, 8.5.2 [K.Atkinson and W.Han, Elementary Numerical analysis]
15	19.05.22 19.05.22	The finite difference method for second order linear differential equations.	Chapter 8.7.2, 8.8 [K.Atkinson and W.Han, Elementary Numerical analysis] **Quiz (10 pts)**
16	26.05.22	The finite difference method for second order linear differential equations.	Chapter 8.7.2, 8.8 [K.Atkinson and W.Han, Elementary Numerical analysis]
	TBA	**FİNAL EXAM**	

This syllabus is a guide for the course and any modifications to it will be announced in advance.