Kazakh-British Technical University
School of Applied Mathematics

SYLLABUS

Discipline: **Numerical Methods for MCM**
Number of credits: **3 credits (2/0/1)**
Terms: **Autumn 2023**
Name/Initials of the teacher: Kenzhebayev Talgatbek Saduahasovych

Information about the teacher	Time and place		Contact information	
	Room	Office hours (TSIS)	Tel.:	e-mail
candidate of physical and mathematical sciences, associate professor	315	315	2726935	tkenzhebaev@mail.ru

Goals and Objectives:

The goal of Numerical Methods is to teach students how to apply computational methodologies to solve engineering problems when no closed-form, analytical solution exists. Achievement of this goal requires learning the basics of structured programming as well as learning how to combine engineering knowledge, judgment, and intuition to develop reasonable approximations through the engineering modeling process. Emphasis will be placed on understanding the basic concepts behind the various numerical methods studied, implementing basic numerical methods using the MATLAB structured programming environment, and utilizing more sophisticated numerical methods provided as built-in MATLAB functions. This approach is taken since understanding how numerical methods work is essential for choosing the correct method and understanding its limitations.

By the end of this course, students should be able to do the following:

Sturcutred programming. Understand basic structured programming concepts involving decision making, loops, functions, and parameter passing implemented within the MATLAB programming environment.

Numerical methods. Understand the most common numerical methods used in engineering analysis, when to use each method, and how to implement basic methods in a structured manner using MATLAB's programming language.

Numerical accuracy. Estimate the amount of error inherent in different numerical methods.

Numerical efficiency. Assess the efficiency of a selected numerical method when more than one option is available to solve a certain class of problem.

Numerical stability. Understand the convergence properties and limitations of different numerical methods.

Study Materials:

Main Textbooks

[1]. *J.H.Mathews, K.D.Fink.* Numerical Methods using MATLAB. 3^d edition. Prentice Hall. 1999.

[2]. **S.T. Karris.** Numerical Analysis using MATLAB and Excell. 3^d edition. Orchard Publications. 2007.

Course Structure:

Weeks	Topic and Content	References
A	B	C
1	**Topic 1.** Introduction to MATLAB	[1], Ch. 1-13, [2], Ch. 1.
2	**Topic 2.** Error Analysis. Binary Numbers. Machine Numbers. O-notations	[1], Ch. 1, p. 14-39.
3	**Topic 3.** The Solution of Nonlinear Equations. Root Approximation. Newton-Raphson and Secant Methods. MATLAB and Excel Computations.	[1], Ch. 2, p. 40-100. [2], Ch. 2.
4	**Topic 4.** The Solution of Linear Systems. Introduction to Vector and Matrix. Determinants. Cramer's Rule. Gaussian Elimination Method. The Inverse of a Matrix. MATLAB and Excel Computations.	[1], Ch. 3, p. 101-186. [2], Ch. 3.
5	**Topic 5.** Interpolation and Polynomial Approximation. Introduction to Interpolation. Lagrange Approximation. Newton Polynomial. MATLAB and Excel Computations.	[1], Ch. 4, p. 187-251. [2], Ch. 7.
6	**Topic 6.** Curve Fitting. Least-squares Line. Interpolation by Spline Functions.	[1], Ch. 5, p. 253-309. [2], Ch. 6.
7	**Topic 7.** Numerical Differentiation. Approximating the Derivative. Numerical Differentiation Formulas.	[1], Ch. 6 p. 310-341.
8	**Topic 8.** Numerical Integration. The Trapezoidal Rule. Simpson Rule. MATLAB and Excel Computations.	[1], Ch. 7, p. 443-468. [2], Ch. 10.
9	**Topic 8.** Numerical Integration. Recursive Rule and Romberg Integration. MATLAB and Excel Computations.	[1], Ch. 7, p. 468-482
10	**Topic 9.** Solution of Differential Equations. Euler Method. Taylor Series Method. MATLAB and Excel Computations.	[1], Ch. 9, p. 427-458. [2], Ch. 12
11	**Topic 9.** Solution of Differential Equations. Runge-Kutta Methods. MATLAB and Excel Computations	[1], Ch. 9, p. 458-474. [2], Ch. 12
12	**Topic 10.** Solution of Partial Differential Equations. Hyperbolic Equations. Finite-Difference Method.	[1], Ch. 10, p. 514 - 538.
13	**Topic 10.** Solution of Partial Differential Equations. Parabolic Equations. Forward -difference Method. MATLAB Computations.	[1], Ch. 10, p. 514 - 538.
14	**Topic 10.** Solution of Partial Differential. Parabolic Equations. Implicit scheme. Tridiagonal matrix algorithm. MATLAB Computations	[1], Ch. 10, p. 514 - 538.
15	**Topic 10.** Solution of Partial Differential Equations. Elliptic Equations. MATLAB Computations	[1], Ch. 10, p. 514 - 538.

Grading criteria

Types of tasks	Scores
Attendance and participations	0
SIS: laboratory works	28
Mid-term exam	16
End-term exam	16
Final exam	40
Total	**100**

This table provides criteria for assessing the knowledge and the delivery schedule of the tasks. Each teacher defines the types of tasks and evaluation depending on the specifics of their discipline.

The form the schedule of performance and delivery of works

№	Type of evaluation	Week 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16-17	Total
1	Attendance and participation	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		0
2	Quizzes(lab)			*		*					*		*					28
3	Mid-term exam							*										16
4	End-term exam														*			16
5	Final exam															*		40
	Total																	100

Evaluation System:

Grade in Letter	Grade in Number (GPA)	Grade in percentage %	Grade in traditional system
A	4	95-100	"Excellent"
A-	3,67	90-94	
B+	3,33	86-89	"Good"
B	3	81-85	
B-	2,67	76-80	
C+	2,33	71-75	"Satisfactory"
C	2	66-70	
C-	1,67	61-65	
D+	1,33	56-60	
D	1	51-55	
F	0	< 50	"Fail" (no-go grade)
I	0	0	"Incomplete Discipline"
W	0	0	"Withdraw"
AW	0	0	"Academic Withdraw"
AU	0	0	"Attend Discipline"
P/NP	-	65-100	"Pass/ No Pass"

Grading Policy:
KBTU Standard grading policy is used.
Additional remarks:
- Attendance (always be in time on lectures)
- Read main and additional materials
- Do homeworks
Attention! Attendance must be higher than 70%, student that does not attend without serious reason for more than 30% will receive a failing grade for that course. Student who plagiarizes on examinations will be failed.

Considered in meeting of School of Applied Mathematics, minutes №_1___ «_23_»
_August_____2023 year.

associate professor of School of Applied Mathematics   *Kenzhebayev T.S.*