**Kazakh-British Technical University**

**School of Applied Mathematics**

«APPROVED BY»

*Acting Dean of School of Applied Mathematics* *Kenzhebayev T.S.*

\_\_\_\_\_\_\_\_\_\_\_

on 10.01.2025, protocol №7

**SYLLABUS**

Discipline:  **Classical Boundary Value Problems and Numerical Methods. MatLab**

Number of credits: **3 credits** **(2/0/1)**

Terms: **Spring 2025**

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 | 317 | 317 | 2726935 | t.kenzhebaev@kbtu.kz |

# Goals and Objectives:

This course provides an introduction to the theory, solution, and application of differential equations with boundary values. Topics discussed in the course include methods of solving second-order differential equations, existence and uniqueness theorems, second-order linear equations, power series solutions, systems of equations, non-linear equations and applications. An introduction to numerical solutions is also provided. Applications of differential equations in physics, chemical engineering are presented. The goal of this course is to provide the student with an understanding of the solutions and applications of differential equations with boundary values.

### The objectives:

* Solve eigenvalue problems
* Solve partial differential equations using Fourier series methods.
* Apply differential equations to problems in chemical engineering, physics, biology and economics.
* Use MATLAB (Python) to solve and analyze solutions of differential equations with boundary values

# Study Materials:

***Main Textbooks***

[1] William F.Trench. *Elementary Differential Equations with Boundary Value Problems*, 2013

[2] William F.Trench. *Student Solutions Manual for Elementary Differential Equation*, 2013

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

[4] S.T. Karris. *Numerical**Analysis using MATLAB and Excel*. 3d edition. Orchard Publications. 2007.

# Course Structure:

|  |  |  |
| --- | --- | --- |
| **Weeks** | **Topic and Content** | **References** |
| **A** | **B** | **C** |
| 1 | Fourier expansions I. Eigenvalue problems for the differential equation . Problems 1,2. | [1] Ch 11.1 |
| 2 | Eigenvalue problems for the differential equation . Problems 3,4,5. | [1] Ch 11.1 |
| 3 | Orthogonality. Fourier Series I. Convergence of Fourier Series I. | [1] Ch 11.2 |
| 4 | Even and Odd Functions. Fourier series for even and odd functions. | [1] Ch 11.2 |
| 5 | Fourier expansions II. Fourier Cosine and Sine Series. Convergence. | [1] Ch 11.3 |
| 6 | Mixed Fourier Cosine Series. Mixed Fourier Sine Series. Convergence. | [1] Ch 11.3 |
| 7-8 | Fourier Solutions of Partial Differential Equations. The initial-boundary value problems for Heat Equations. Convergence. | [1] Ch.12-1 |
| 9 | The Nonhomogeneous initial-boundary value problems for Heat Equations. | [1] Ch.12-1 |
| 10-11 | The initial-boundary value problems for Wave Equations. Convergence. | [1] Ch.12-2 |
| 12 | The initial-boundary value problems for Laplace Equations in Rectangular Coordinates. | [1]Ch.12-3 |
| 13 | Laplace’s Equation for a Semi-Infinite Strip. | [1]Ch.12-3 |
| 14 | Boundary value problems for linear second order ordinary differential equations. Two-point boundary value problems. | [1]Ch.13-1 |
| 15 | Boundary value problems for linear second order ordinary differential equations. Sturm-Liouville problems. | [1]Ch.13-2 |

**Grading criteria**

|  |  |
| --- | --- |
| **Types of tasks** | **Scores** |
| Home work | 10 |
| Laboratory work | 20 |
| Mid-term exam | 15 |
| End-term exam | 15 |
| 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.

**V. Evaluation System:**

|  |  |  |  |
| --- | --- | --- | --- |
| **Grade in Letter** | **Grade in Number (GPA)** | **Grade in percentage %** | **Grade in traditional system** |
| A | 4 | 95-100 | "Excellent" |
| A- | 3,67 | 91-94 |  |
| B+ | 3,33 | 86-90 | "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" |
| Pass / No Pass |

**Grading Policy:**

KBTU Standard grading policy is used. The final exam will be in written form.

**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.

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