SYLLABUS
The mathematical model of heat transfer in a multi-region

1. GENERAL INFORMATION	
Faculty	Information Technology
Major code and title	5B070500 - Mathematical and computer modeling
Year, semester	3nd year, 5th semester
Subject category	Profile
Number of Credits	3
Language of Delivery:	English
Prerequisites	Differential Equations, The Equations of Mathematical Physics, Algorithms, Programming languages
Postrequisites	Disciplines of engineering and energy/
Lecturer	Muhametkalieyva N., MSc, office # 808, nazerkem09@gmail.com Office hours: Tuesday 10:00-12:00
Instructors	Muhametkalieyva N.

Course goal: The course is intended for students of the third year degree in mathematics and computer modeling. Solutions of equations of mathematical physics describe the most important for the study of the Earth's interior and atmosphere processes such as the spread of seismic, electromagnetic and acoustic waves, heat, filtration processes, the temperature regime pipeline and wells, and many others. Numerical methods allow you to model, and hence to study these processes. Numerical methods also allow us to solve the inverse problems of geophysics, which arose in the early twentieth century and has since spread to all areas of applied mathematics, geophysics, medicine, mathematics of finance.

Learning outcomes:

- - to acquire a good knowledge of problem solving with bringing solutions till the practically acceptable result;
- - develop skills in mathematical analysis of applied management and the ability to independently understand the mathematics.

3. COURSE DESCRIPTION

Study of discipline " The mathematical model of heat transfer in a multi-region" implies obligatory lectures (1 credits) and labs (2 credit) classes, as well as individual work of students (SIS and TSIS). Such comprehensive lessons provide an assimilation of the course; help students acquire the fundamental systematic knowledge.

4. COURSE POLICY

Students are forbidden to:

- submit any tasks after the deadline. Late submissions are graded down.
- cheat. Plagiarized papers shall not be graded;
- be late for classes;
- retake any tests, unless there is a valid reason for missing them;
- use mobile phones in class.

Students should always

- be appropriately dressed (formal/semi- formal styles are acceptable);
- show consideration for and mutual support of teachers and other students;
- let the teacher know of any problems arising in connection with their studies.

5. LITERATURE

Required literature

1. Ф.Ф.Цветков, Б.А. Григорьев Тепломассаобмен, Москва, Из-во: МЭИ, 2005.

2. Галин Н .М , Кириллов П.Л. Тепломассообмен (в ядерной энергетике): Учебное пособие для вузов. М.: Энергоатомиздат, 1987. 3. Пасконов В.М., Полежаев В.И., Чудов Л.А. Численное моделирование процессов тепло- и массообмена. М.: Наука, 1984. 4. М.А. Лаврентьев, Б.В. Шабат Методы теории функций комплексного переменного. Москва, 1973, 736 с. **Supplementary literature**: 1. Карташов Э.М. Аналитические методы в теории теплопроводности твердых тел: Учебное пособие для вузов. М.: Высшая школа, 1985. 2. Лыков А.В. Теория теплопроводности. М.: Высшая школа, 1967. 3. Патанкар С. Численные методы решения задач теплообмена и динамики жидкости: Пер. с анг. М.: Энергоатомиздат, 1984. 4. Н.С. Пискунов Дифференциальное и интегральное исчисления. Москва, 1978, 575 с.

6. Course Content

6.1 Lecture, practical session plans

	Abbreviation	Meaning
	TSIS	Teacher-supervised independent work (СРСП)
	SIS	Students' independent work (СРС)

Week No	Lectures	Lectures (1 h/w)	Practical classes (1 h/w)	Labs (2 h/w)	T/SIS (4 h/w)
1	The heat equation. Law of conservation of energies. Gradient and divergence. Heat flow. The stationary problem. Hypotheses	1	2	1	4
2	Boundary conditions. Exact solution of a one-dimensional stationary problem. Approximation. Difference scheme. The method of Thomas. Laboratory work №1. Checking the accuracy of the scheme.	1	2	1	4
3	Boundary conditions of the 4th kind. Solution of the stationary problem in an inhomogeneous medium.	1	2	1	4
4	Homogeneous difference scheme for a non-homogeneous problem. Approximation and accuracy of the scheme. Laboratory work №2. Checking the accuracy of the scheme.				
5	Equation of thermal conductivity in the polar coordinate system. The stationary problem in the cylindrical region. Boundary conditions. Exact solution of the problem. The difference problem. The accuracy of the scheme. Laboratory work №3. Checking the accuracy of the scheme.	1	2	1	4
6	Equation of thermal conductivity in a spherical coordinate system. Boundary conditions. Exact solution of a one-dimensional stationary problem. Laboratory work №4.	0.5	2	1	4

7	Integro-interpolation method. Difference derivatives of the first and second order. Approximation. The accuracy of the problem. Convergence and stability.	0.5	2	1	4
	Mid Term		1		
8	One-dimensional heat distribution in a rectangular region. Exact solution of the problem in an infinite domain $(-\infty; +\infty)$. An explicit scheme. The order of approximations. Convergence. Courant's condition.	1	1	2	6
9	Algorithm for solving the difference problem. Comparison of an approximate solution with an exact solution. Laboratory work №5.	1	1	2	6
10	Distribution of heat in the rod in cases of constant temperature at the ends of the region. Formulation of the problem. Exact solution. Balance method. Implicit difference problem. The order of approximations. The method of Thomas.	1	1	2	6
11	Algorithm for solving the heat distribution problem in cases of constant temperature at the ends of a rectangular region. Program. The boundaries of the thawed and frozen zone (in winter). Stability.	1	1	2	6
12	Scheme Crank-Nicholsen. The order of approximations. The method of Thomas. Algorithm for solving the problem. Program. Computational experiment. Comparison of an approximate solution with an exact solution. Laboratory work № 6.	1	1	2	6
13	Nonstationary problem in a cylindrical region. Initial boundary conditions. Balance method. The order of approximations. Algorithm and program.	1	1	2	6
14	Nonstationary one-dimensional problem in the spherical region. Initial boundary conditions. Balance method. The order of approximations. Algorithm and program. Laboratory work № 7.	1	0	2	6
	End-term		1		
15	Multidimensional problems of hyperbolic type. Methods. Calculating formulas. Algorithm.	1	1	2	6
TOTAL		**15**	**15**	**30**	**90**

7. Student performance evaluation system for the course

Formative assessment (60%)				Summative Assessment (40%)	
Appraisal period I		Appraisal period II		Examination	
Laboratory classes	50 %	Laboratory classes	50 %	Examination	100%
Mid-term (Quiz)	50 %	End-term (Quiz)	50 %		
Total	100 %	Total	100 %	Total 100%	
Gross Total				100	

If the number of absences exceeds 20%, student will be automatically scheduled for a Retake (summer semester)

Achievement level as per course curriculum shall be assessed according to the evaluation chart adopted by the academic credit system:

Letter Grade	Numerical equivalent	Percentage	Grade according to the traditional system
A	4,0	95-100	Excellent
A-	3,67	90-94	
B+	3,33	85-89	Good
B	3,0	80-84	
B-	2,67	75-79	
C+	2,33	70-74	Satisfactory
C	2,0	65-69	
C-	1,67	60-64	
D+	1,33	55-59	
D	1,0	50-54	
F	0	0-49	Fail

8. Methodological guidelines

Assessment is administered continuously throughout the course. The students are rated against their performance in **continuous rating** administered throughout the semester (credited 60%) and **summative rating** done during the examination session (credited 40%), total **100%. Continuous rating** is students' on-going performance in class, homework and independent work. Class work is assessed for attendance and activity on practice lessons.

Teaching methodology

Theory classes:

- lectures developing the theoretical aspects of the subject
- practical classes aimed at applying theory to problems.

Workshop classes:

- practical classes in which students solve problems in groups or individually.

SIS (Student Independent Study) to be done by students independently and checked in class.

Mid-term is realized as a control work by solving exercises for the initial 6-7 weeks.
End-of-term is realized as a control work by solving exercises for the rest weeks.
Final examination is a computer test (30 questions for 80 minutes: question include both theoretical questions and practical exercises).