**International IT University**

Faculty of Computer technologies and cyber security

Department: MCM



**Report**

In the discipline «Numerical Analysis»

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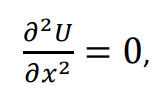
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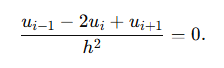
Almaty, 2025

Task 1: 1D Laplace Equation

1. We have formula:

 where 𝑥 ∈ [0, 𝐿]

1. Approximate by the finite difference method:



1. So coefficients for Tomas’s method are:

• ai ​= 1 (нижняя диагональ)

• bi ​= −2 (главная диагональ)

• ci = 1 (верхняя диагональ)

• di = 0 (правая часть)

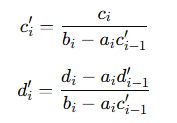
1. Thomas’s Method applies to a three-diagonal system:



1. At start, we need to use a straight line:

1. For other lines:



1. Now we have to find reverse gear:



Сode and graph:

*import* numpy *as* np  
*import* matplotlib.pyplot *as* plt  
  
  
*def* thomas\_algorithm(a, b, c, d):  
 n = len(d)  
 c\_ = np.zeros(n-1)  
 d\_ = np.zeros(n)  
  
 c\_[0] = c[0] / b[0]  
 d\_[0] = d[0] / b[0]  
  
 *for* i *in* range(1, n-1):  
 c\_[i] = c[i] / (b[i] - a[i] \* c\_[i-1])  
  
 d\_[0] = d[0] / b[0]  
 *for* i *in* range(1, n):  
 d\_[i] = (d[i] - a[i-1] \* d\_[i-1]) / (b[i] - a[i-1] \* c\_[i-1])  
  
 u = np.zeros(n)  
 u[-1] = d\_[-1]  
  
 *for* i *in* range(n-2, -1, -1):  
 u[i] = d\_[i] - (c\_[i] \* u[i+1] *if* i < n-1 *else* 0)  
  
 *return* u  
  
  
L = 1.0  
N = 10  
h = L / (N + 1)  
A, B = 0, 1  
  
a = np.ones(N-1)  
b = -2 \* np.ones(N)  
c = np.ones(N-1)  
d = np.zeros(N)  
  
d[0] -= A  
d[-1] -= B  
  
u = thomas\_algorithm(a, b, c, d)  
  
x = np.linspace(0, L, N+2)  
u\_full = np.concatenate(([A], u, [B]))  
  
plt.plot(x, u\_full, 'o-', label="Численное решение")  
plt.xlabel("x")  
plt.ylabel("u(x)")  
plt.legend()  
plt.grid()  
plt.show()

