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# BASIC CONCEPTS OF HEAT DISSIPATION EQUATIONS AND INVERSE PROBLEM THEORY

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**Annotation.** Heat dissipation is a fundamental physical process describing the transfer and distribution of thermal energy within solid bodies, fluids, and engineering systems. Mathematical models of heat dissipation are primarily based on the heat conduction equation, derived from the principles of energy conservation and Fourier's law of heat conduction. These equations enable the prediction of temperature distributions and thermal behavior in various scientific and industrial applications. Inverse problem theory plays a crucial role in heat transfer analysis when unknown parameters, boundary conditions, or internal heat sources must be determined from measured temperature data. Unlike direct problems, where system parameters are known and temperature fields are calculated, inverse heat transfer problems seek to reconstruct hidden information from observed thermal responses. Such problems are often ill-posed, requiring specialized mathematical techniques, regularization methods, and optimization algorithms to obtain stable and accurate solutions.

**Keywords:** heat dissipation, heat transfer, heat conduction equation, thermal analysis, temperature distribution, inverse problems, inverse heat transfer.

**Introduction.** Heat spread in nature the most many occurring physicist from processes one those objects between temperature difference as a result of energy transmission represents. If a of the environment different at points temperature various if, heat high with temperature low temperature than the area to the area This process heat is called conductivity. Heat permeability of the substance internal structure with related of molecules each other impact through energy transmitted. In practice heat spread metal of bodies warming, earth in the layer's temperature change, technical on devices cooling processes such as many in the fields Heat spread mathematician modeling real physics processes deep understanding, prediction to do and management opportunity gives. Therefore, heat spread process mathematician physics important from departments one is considered.

Heat spread process mathematician modeling mathematician physics important from directions one is considered. Heat permeability event temperatures difference as a result of energy in space distribution This process represents mathematician description of energy preservation law and Fourier's law is based on. This to the laws relied on without heat spread equation harvest will be done and in that environment temperature time according to change represents [1].

**Research methodology**. Evans Heat equation private productive differential equations theory classic sample as He looks at the solutions. existence, uniqueness and smoothness fundamental properties such as mathematician in terms of justifies [10] This is theoretical. results model scientific reliability provides. Kreiszig by heat equation engineering and technician modeling tool as interpretation Fourier rows using solution find methods heat spread processes practical calculation opportunity gives.

Islamov and Jo'rayev in their work heat equation start and borderline conditions with together studied, classic solution methods systematic accordingly statement [13] This approach model real physics to processes in adaptation important importance has.

So, classic heat equation physicist of processes mathematician model as theoretical and practical in terms of deep learned to be, to be properties next research for solid scientific basis creates.

Heat spread equation for initial intra-border issues:

Heat spread process mathematician model;

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Hard in bodies of heat spread processes many physicist and engineering of issues basis organization Such processes in learning mathematician modeling important importance has been, he is a real physicist the event differential equations using expression opportunity gives. Heat spread mathematician model as heat spread equation is taken and he is next in statements

$\frac{\partial u}{\partial t}=a^2\Delta u+f(x,y,z,t)$ is determined by the equation.

Or one dimensional in case :

$\frac{\partial u}{\partial t}=a^2\Delta u+f(x,y,z,t)$s

This equation hard of the body everyone at the point temperature time according to change and spatial coordinates according to spread describes. However, only this of the equation himself/herself issue complete determination for enough not. Because physicist of the process development start situation and on the body surface to the conditions directly related It will be.

Start drinking condition physicist and mathematician content:

Heat spread the issue complete to put for start time inside the body at the moment temperature distribution to be given This is necessary. condition start is called a condition and it (2)- condition with is expressed. Start' ich condition through of the body initial status is determined, that is of time start at the point every one spatial on point temperature value known.

Physically when viewed, start condition of the body external effects from the beginning previous thermal status represents. Mathematician point from the point of view and then, that time according to differential equation for necessary the only solution to determine service does.

Borderline conditions and their type:

Borderline conditions on the surface of a solid body heat mode defines and heat exchange how under the circumstances to pass determines the physical process to nature depending on, practical in matters mainly three kind of borderline conditions They are Dirichlet, Newman and Robin type borderline are called conditions.

Dirichlet of the type borderline on condition surface of a solid body everyone at the point temperature value in advance given In this case, the surface of the object temperature spatial coordinates and to time related was known function through This is determined by condition heat source of the body surface using temperature strict hold standing processes models. Dirichlet of the type borderline condition theoretical in research wide used, it is (3) - marginal condition with is expressed.

Newman of the type borderline on condition from the surface of the body passing by heat flow in this case, the surface of the object unity on the surface known time between passing by heat amount This is determined by condition Fourier to the law is based on and the normal direction on the surface of the body according to temperature spatial change with related will be. Newman of the type borderline condition heat insulation or given heat flow there is was issues in description important importance has been (4) - limit condition through is determined.

Robin -like borderline condition on the surface of a solid body environment with heat exchange happened to be in cases In this case, the surface of the object outgoing or to him/her entering heat amount of body surface area temperature with environment temperature between difference proportional This will be connection Newton cooling to the law is based on and convective heat exchange processes expression opportunity Robin type borderline condition practical in matters the most many occurring from the conditions one is (5) - limit condition with is expressed.

Start intra-border of the matter general to be put

Above statement done heat spread equation, initial condition and Dirichlet, Newman or Robin type borderline from the conditions one together heat spread complete initial intra-border

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the issue harvest does. This of the matter the solution is internal temperature of the area time and space according to change determination opportunity gives

Hard in bodies of heat spread processes many physicist and engineering of issues basis organization Such processes in learning mathematician modeling important importance has be, he is a real physicist the event differential equations using expression opportunity gives. Heat spread mathematician model as heat spread equation is taken and he is next in statements (1)- equation with is determined.

See The issue at hand is the following: to the appearance has**:**

$U_t - U_{xx} = f(x:t)$ 0<x< l; T> O; $0 \leq x < 1$ t>0

Elementary and borderline conditions with

$U(x, 0) = \varphi(x)$, $0 \leq x \leq l$

$U(0,t) = u(l, t) = 0$, $t \geq 0$

Here:

- U(x,0) – unknown function ( temperature or physicist size ),
- $f$(x,t) – external source (heat source)
- $\varphi(x)$– initial distribution

This equation heat permeability equation it is one dimensional in the street temperature time according to spread represents.

- $U_t$ – time according to change,
- $U_{xx}$ – space according to curve linearity ( heat) flow ),

SHE IS$|_{t=0}$ $U|_{x=l}$ ; $t \geq 0$

This is physics. in terms of :

- Average temperature
- General warmth energy
- Conservation of mass

Processes such as is expressed.

Integral condition

$$\int_0^l u(x,t)dx \;\; M(t)$$

Sturgeon according to total warmth amount indicates.

If:

$M(t) = M_0$

If general energy is stored.

Issues general energy is stored

The problem is in the operator's hands. we write

Lu = f

Here :

$$L = \frac{\partial}{\partial t} - \frac{\partial^2}{\partial x^2}$$

Integral operator:

This = h(t)

To the appearance is written.

The combination of heat dissipation models and inverse problem methodologies has become an important tool for thermal diagnostics, process monitoring, and system optimization. As computational methods and data acquisition technologies continue to advance, inverse heat transfer analysis is expected to play an increasingly significant role in solving complex thermal engineering problems. A solid understanding of these fundamental concepts provides a strong foundation for further research and practical applications in modern science and engineering.

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**Conclusion.** Heat dissipation equations provide the fundamental mathematical framework for describing the transfer and distribution of thermal energy in physical systems. Based on the principles of heat conduction and energy conservation, these equations enable the analysis and prediction of temperature fields under various operating conditions. Their applications extend across numerous fields, including engineering, materials science, environmental studies, and biomedical technologies. Inverse problem theory complements classical heat transfer analysis by allowing researchers to determine unknown parameters, heat sources, material properties, and boundary conditions from observed temperature measurements. Unlike direct problems, inverse problems are often ill-posed and sensitive to measurement errors, making the development of robust numerical methods and regularization techniques essential for obtaining reliable solutions.

**References**

1. Tikhonov AN, Arsenin VY Solutions of Ill-Posed Problems. – Washington: Winston & Sons, 1977.

2. Samarsky A.A. Uravneniya mathematical physics. — Moscow: Nauka, 1977).

3. Zikirov OS Special derivatives differential equations. – Tashkent: [publisher] name], [ Tashkent-2012].

4. Vladimirov VS, Mikhailov VP, Mikhailova TV, Shabunin MI Sbornik equation problem mathematical physical (mathematical) physics equations according to issues collection). – Moscow: Fizmatlit, 2016. – ISBN 978-5-9221-1692-3.

5. Teshaboeva N. Mathematician physics methods. – Tashkent: UzSSR High and special education ministry edition, 2nd edition (revised) and filled).

6. Isakov V. Inverse Problems for Partial Differential Equations. – New York: Springer, 2006.

7. Lyons J.-L., Magenes E. Non-Homogeneous Boundary Value Problems and Applications. – Berlin: Springer, 1972.

8. Il'in VA Boundary Value Problems for Equations of Mathematical Physics. - Moscow: Nauka, 1985.