**World of Science: Journal on Modern Research Methodologies**

*Volume 2 Issue 5, Year 2023*
*ISSN: 2835-3072*
*https://univerpubl.com/index.php/woscience*

# About the Existence and Uniqueness of the Tricomi Issue Solution for a Special Type Equation

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**Article Information**

**Received:** March 20, 2023
**Accepted:** April 21, 2023
**Published:** May 22, 2023

**Keywords:** *lines of degeneracy, equation of mixed type, reguylar solution, and boundary value problem.*

**ABSTRACT**

*This article discusses the problems of the local boundary value problem for elliptical-parabolic equation of mixed type with different orders of degeneracy.*

The article describes the uniqueness of the local boundary problem solution for a mixed elliptic-parabolic type equation with different order perturbation lines as

$$0=\begin{cases} y^{m_1}u_x - x^{n_1}u_y, x>0 \\ y^{m_2}u_x + (-x)^{n_2}u_y, x<0 \end{cases} \quad (1)$$

we look at the equation in the field D⊂R2. Where D is the area x>0 at u=0, x=H1, y=h2 at OA, AV, VV0, intersections of straight lines and x<0

$$\sigma: \frac{1}{q_2^2}(-x)^{2q_2}\frac{1}{p_2^2}y^{2p_2}=1$$

the smooth line y=0 is bounded by the A0O cross section of the straight line,$0<m_1<m_2+1$, $n_i=const(i=1,2)$, $h_1=(2q_1)^{1/q_2}$, $h_2=p_2^{1/p_2}$, $h=q_2^{1/q_2}$, $2q_1=n_1+2$, $2q_2=n_2+2$, $2p_2=m_2+2$.

(1) the equation applies to the parabolic type at x>0, y>0, and to the elliptic type at x<0 , y>0.

It is known that for Equation (1) in the infinite field, local and nonlocal boundary issues [1], [2] are studied in the works.

Let's enter the mark:

$$D_1=\{(x,y): 0<x<h_1, 0<y<h_2\}, D_1=\{(x,y): -h<x<0, 0<y<h_2\}.$$

Satisfying the following conditions, $U(x, y)$ is called a regular oriclassic solution of the function (1) equation.

1) $u(x, y) \in C^{2,1}(D_1) \cap C^2(D_2)$;

2) *u(x, y)-(1)* satisfies the equation in fields D1 and D2..

**Tikomi issue.** Define a function U(x, y) satisfying these conditions**:**

1) $u(x, y) \in C(\overline{D}) \cap C^1(D)$;

2) *u(x, y)-(1)* the regular solution of the equation in fields D1 and D2 is;

3) *U (x, y)*- satisfies the following conditions:

$$u(x, y)\big|_{\sigma} = \psi(x, y), (x, y) \in \sigma,$$

$$u_y\big|_{y=0} v_0(x), -h < x < 0,$$

$$u\big|_{y=0} \varphi_1(x), 0 \le x \le h_1,$$

$$u\big|_{y=h} \varphi_2(u), 0 < u < h_2,$$

where the given ψ (x, y), v0 (x), φ1 (x), φ2 (u), are the functions,

$$v_0(x) \in C^1(-h < x < 0)$$

$$\varphi_1(x) \in C(0 \le x \le h_1) \cap C^2(0 < x < h_1)$$

$$\varphi_2(u) \in C(0 \le y \le h_2) \cap C^1(0 < y < h_2)$$

$\psi(x, y)$ and the function ψ(x, y)= xy ψ(x, y), ψ (x, y) ∈ S ( σ).

The following theorem is valid.

**Theorem** (extremum principle). The solution to the Trikomi problem, or domain D, is achievable at its positive maximum and negative minimum ( σ) ∪ A0O ∪ ( OA) ∪( AV).

Directly from the extremum principle comes the uniqueness of the Trikomi Question Solution for Equation (1).

It is known that the equation being considered with respect to an unknown function is called a functional equation. For example, expressing the property that a univariate function has a pair, a tangle, an excitable point, this

$$f(x) = f(-x), f(x) = -f(x), f \circ f(x) = x$$

peers consist of functional equations. The functional equation can be one or more variables. The following equations f (x) = f(x/2), f(x)= cos 1/2 f(x/2), f (0)=1 (f is a continuous function) are examples of one-variable functional equations.

Two variables $f(x+y) = f(x) + f(y)$, $f(x+y) = f(x) f(x)$:

$$f(x) = f(x) + f(y), f(x) = f(x) f(y)$$

functional equations are called Cauchy equations. At the same time we can cite the equation f (x+y)/2) = (f (x)+f(y))/2 - Iynsey and the equation f(x+y)+f(x-y)=2f(x)f(y) -Dalamber. Typically, fuchsian equations have many solutions. Often the direct solution of the equation presents some difficulty. But it is possible to solve the functional equation based on some characteristic properties of the function being sought.

If the series are given by a reccurrent Fourier in the form of functional equations, we show in examples that the nonmalum coyefficents of such series can be determined using the solution of the functional equation.

**Example 1**. This function F(z)=(1-qz) (1-q^2 z) (1-q^3 z) ...(|q|<1) is known to extend to the rank row in the Form F(z) = A0 + a1z + a2z2 + a3z3 + ... Define the An-coyefficents of the

series shown using the functional equation F(z)=(1-qz) F(qz). **Undo. In order of citation** $F(z) = (1 - qz)\ (1 - q^2z)\ (1 - q^3z)\ (1 - q^4z)\ ...(1 - q^nz)\ ... = A_0 + A_1qz + A_2q^2z^2 + A_3q^3z^3 + ...$

And $(1\text{-}qz)\ F(qz) = A_0 + A_1qz + A_2q^2z^2 + A_3q^3z^3 + \ldots - (A_0qz + A_1q^2z^2 + A_2q^3z^3 + A_3q^4z^4 + \ldots) = A0 + (A_1 - A_0)qz + (A_2 - A_1)q^2z^2 + (A_3 - A_4)q^3z^3 + ...$

since is the functional equation given by $A_0 + (A_0 - A_1)qz + (A_2 - A_1)q^2z^2 + (A_3 - A_2)q^3z^3 + \ldots = A_0 + A_1z + A_2z^2 + A_3z^3 + ...$gives a mirror in appearance.Equating the uniform vfrajal coefficents of z

$$(An - An\text{-}1)qn = An,\ n=1,2,3,\ldots$$

gives equality. From this equality

$$A_n = \frac{q^n}{q^n - 1}\ A_{n-1}, n = 1,2,3, ...$$

let the relationship come. Finally, we define the coyefficents that are being sought from the last equality:

$$A_n = \frac{q^{\frac{n(n+1)}{2}}}{(q-1)(q^2-1)\ ...\ (q^n-1)}, n = 1,2,3, \ldots .$$

**Example 2.** It is known that the inverse to

F(z)=(1-qz) (1-q^2 z) (1-q^3 z) ...(|q|<1) is 1/(F(z))=B_0+B_1 z+B_2 z^2+B_3 z^3 + ⋯

visually spread out in a row.

$$F\ (z) = (1\text{-}qz)\ F\ (qz$$

define the Bn coyefficents shown using the functional equation.

Solution. In order of citation $\frac{1}{F(z)} = B_0 + B_1qz + B_2q^2z^2 + B_3q^3z^3 + \cdots$

since the functional equation

$$\frac{1}{F(qz)} = \frac{1 - qz}{F(z)}$$

taking advantage of the fact that it looks,

$$B_0 + B_1qz + B_2q^2z^2 + B_3q^3z^3 + \ldots = B_0 + B_1z + B_2z^2 + B_3z^3 + \ldots - (B_0qz + B_1q^2z^2 + B_2q^3z^3 + B_3q^4z^4 + \ldots) = B_0 + (B_1 - B_0q)z + (B_2 - B_1q)z^2 + (B_3 - B_2q)z^3 + \ldots = B_0 + B_{1q}z + B_2q^2z2 + B_3q^3z3 + \ldots$$

we write equality. Hence the given functional equation

$$B_0 + (B_1 - B_0q)z + (B_2 - B_1q)z^2 + (B_3 - B_2q)z^3 + \ldots = B_0 + B_1qz + B_2q^2z^2 + B_3q^3z^3 + \ldots$$

gives a mirror in appearance.Equating the koyefficents before the same levels of z gives the Equalities.

$$(Bn - Bn\text{-}1Q) = Bnqn,\ n=1,2,3,\ldots$$

From these equalities$B_n = \frac{q}{1-q^n}\ B_{n-1}, n = 1,2,3, ...$

Finally seeking from the last equalities

$$A_n = \frac{q^n}{(1-q)(1-q^2)\ ...\ (1-q^n)}, n = 1,2,3, \ldots .$$

we define coyefficents

**Conclusion.** For special types of equations, the specificity of the Tricomi problem is related to the shape and complexity of the problem. When the issue is complex, solving it will make the Tricomi issue even more difficult to apply. In addition, the Tricomi question is a widely used method for finding a solution and is important in finding a solution for special types of equations.

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