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Institute of Theoretical and Applied Mathematics

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В сборник включены тезисы докладов по следующим разделам математики: "Топология и геометрия", "Обыкновенные дифференциальные, разностные и интегральные уравнения", "Дифференциальные и интегральные уравнения с частными производными", "Оптимизация, численные методы и прикладная математика", "Математика в образовании". В них отражены состояние и проблемы современной математики и ее приложения.

The collection contains abstracts of reports on the following branches of mathematics: Topology and Geometry; Ordinary Differential, Difference and Integral Equations; Partial Differential and Integral Equations; Optimization, Numerical and Applied Mathematics; Mathematics in Education. They present the up-to-date state and problems of mathematics and its applications.

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INTEGRAL BOUNDARY VALUE PROBLEM WITH TWO BOUNDARY LAYERS FOR SINGULARLY PERTURBED DIFFERENTIAL EQUATION

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Consider the following linear differential equation of the third order with small parameters at the two highest derivatives

$$L_\varepsilon y \equiv \varepsilon^2 y''' + \varepsilon A(t) y'' + B(t) y' + C(t) y = F(t),\ t \in [0,1] \tag{1}$$

with boundary conditions

$$y(0,\varepsilon) = \alpha, \quad y'(0,\varepsilon) = \beta, \quad y(1,\varepsilon) = \gamma + \int_0^1 \sum_{i=0}^{1} a_i(x) y^{(i)}(x,\varepsilon)dx \tag{2}$$

where $\varepsilon > 0$ is a small parameter, α, β, γ are known constants independent of ε.

Assume that following conditions hold:

I. Functions $A(t)$, $B(t)$, $C(t)$, $F(t)$, $a_i(t)$, $i = 1, 2$ are sufficiently smooth and defined on the interval $0 \le t \le 1$.

II. The roots of "additional characteristic equation" $\mu^2 + A(t)\mu + B(t) = 0$ satisfy the following inequalities $\mu_1(t) < -\gamma_1 < 0$, $\mu_2(t) > \gamma_2 > 0$.

III. $a_1(1) \neq 0$.

Theorem 1. *If the conditions I-III are valid, then for the solution $y(t,\varepsilon)$ of the boundary value problem (1)-(2) and its derivatives the following asymptotic estimation holds as $\varepsilon \to 0$:*

$$|y^{(i)}(t,\varepsilon)| \le C(|\alpha| + \varepsilon|\beta| + \max_{0\le t\le 1}|F(t)|) + \frac{C}{\varepsilon^{i-1}} e^{-\gamma_1 \frac{t}{\varepsilon}} (|\alpha| + |\beta| +$$

$$+ \max_{0\le t\le 1}|F(t)|) + \frac{C}{\varepsilon^i} e^{-\gamma_2 \frac{1-t}{\varepsilon}} (|\alpha| + \varepsilon|\beta| + |\gamma| + \varepsilon \max_{0\le t\le 1}|F(t)|), \quad i = \overline{0,2}$$

where $C > 0$ is a constant independent of ε.

The theorem implies that the solution of the problem (1)-(2) at point $t = 0$ has the phenomenon of the first order initial jump and at point $t = 1$ has the phenomenon of the zero order initial jump, i.e. $y''(0,\varepsilon) = O\left(\frac{1}{\varepsilon}\right)$, $y'(1,\varepsilon) = O\left(\frac{1}{\varepsilon}\right)$, $y''(1,\varepsilon) = O\left(\frac{1}{\varepsilon^2}\right)$, $\varepsilon \to 0$.

In this case we say that the solution of the boundary value problem (1)-(2) has the phenomena of the boundary jumps.

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