BIR JINSLI BO`LMAGAN DIFFERENSIAL TENGLAMALAR SITEMASINI “REZONANS” VA “REZONANS” BO`LMAGAN HOLLAR UCHUN YECHIMLARINI TUZISH

[1]*M.N.Xolyigitova*

[2]*A.O.Suyarov*

[1]*o‘qituvchi, Jizzax davlat pedagogika universiteti*

[2]*o‘qituvchi, Jizzax politexnika instituti*

Annotatsiya: Ushbu maqolada bir jinsli bo`lmagan differensial tenglamalar sitemasini “rezonans” va “rezonans” bo`lmagan hollar uchun yechimlarini tuzish ning dolzarbligi tahlil qilingan.

Kalit so`zlar: rezonans, tenglama, differensial tenglama

SOLUTION OF THE SYSTEM OF NON-HOSOME DIFFERENTIAL EQUATIONS FOR "RESONANCE" AND NON-"RESONANCE" CASES

[1]*M.N.Xolyigitova*

[2]*A.O.Suyarov*

[1]*teacher, Jizzakh State Pedagogical University*

[2]*teacher, Jizzakh Polytechnic Institute*

Annotation: In this article, the relevance of creating the solutions of the system of inhomogeneous differential equations for "resonance" and "non-resonance" cases is analyzed.

Key words: resonance, equation, differential equation

Faraz qilaylik “rezonans” bo`lmagan hol o`rinli bo`lsin, ya’ni

$$k^2(t) \neq \lambda_j(t), \forall\ E \in [O, L], j = \overline{1,n} \qquad (1)$$

munosabat bajarilsin.

U holda quyidagi teorema o`rinli.

Teorema 1. Agar $B_s(t)$ vektorlar va $f_s(t)(s=0,1,\ldots)$ funksiyalar hamda k(t) funksiya t bo`yicha cheksiz differensiallanuvchi bo`lsa, u holda (2.1) sistema

$$x(t,E)=p(t,\mu)\exp\left(i\mu^{-h}\theta(t)\right), \quad (2)$$

bunda $p(t,\mu)$ – n – o`lchovli vektor

$$p(t,\mu)=\sum_{s=0}^{\infty}\mu^s p_s(t) \quad (3)$$

darajali qatorga yoyiladi.

Isbot. (3) formal yechimni sistemaga qo`yib

$$\mu^{2h}p''(t,\mu)+2i\mu^h k(t)p'(t,\mu)+i\mu^h k'(t)p(t,\mu)-k^2(t)p(t,\mu)++B\left(t,\mu^2\right)p(t,\mu)=f\left(t,\mu^2\right) \quad (4)$$

ayniyatga ega bo`lamiz.

(4) – ayniyatdan μ parametrning bir xil darajalari oldidagi koeffitsientlarni tenglashtirib

$$\left[B_0(t)-k^2(t)E\right]p_s(t)=\psi_s(t), s=0,1,\ldots \quad (5)$$

cheksiz algebraik tenglamalar sistemasini hosil qilamiz, bunda

$$\psi_s(t)=\left[1-\left\{\frac{s}{2}\right\}\right]f_{\left[\frac{s}{2}\right]}(t)-p''_{s-2h}(t)-2ik(t)p'_{s-h}(t)-ik'(t)p_{s-h}(t)--\sum_{r=1}^{\left[\frac{s}{2}\right]}B_r(t)p_{s-2r}(t) \quad (6)$$

(1) – shartga asosan $\forall\ t\in[O,L]$ uchun

$$det\left[B_0(t)-k^2(t)E\right]\neq 0 \quad (7)$$

bo`lgani uchun (5) – tenglamadan

$$p_s(t)=\left[B_0(t)-k^2(t)E\right]^{-1}\psi_s(t), s=0,1,\ldots \quad (8)$$

ni aniqlaymiz. Teorema isbotlandi.

“Rezonans” bo`lgan hol uchun quyidagi teorema o`rinli.

Teorema 2. Agar $B\left(t,\mu^2\right)$ matritsa $f\left(t,\mu^2\right)$ vektor va k(t) funksiya t bo`yicha cheksiz differensiallanuvchi $[O,L]$ kesmada $C(t)=T^{-1}B_1(t)T(t)$ matritsaning $C_{11}(t)$ elementi nolga teng bo`lmasa va

$$k^2(t)=\lambda_j(t), j=\overline{1,n} \quad (9)$$

shart bajarilsa, – sistema

$$x(t,E)=g(t,\mu)\exp\left(i\mu^{-h}\theta(t)\right) \qquad (10)$$

ko`rinishda formal yechimga ega bo`ladi, bunda $g(t,\mu)-n-¿$ o`lchovli vektor

$$g(t,\mu)=\sum_{s=0}^{\infty}\mu^s g_s(t) \qquad (11)$$

formal darajali qatorga yoyiladi.

Isbot. (11) – vektorni – sistemaga qo`yib

$$\mu^{2h}g''(t,\mu)+2ik(t)\mu^h g'(t,\mu)-ik'(t)\mu^h g(t,\mu)-k^2(t)g(t,\mu)++B(t,\mu^2)g(t,\mu)=f(t,\mu^2)$$

(12)

ayniyatni hosil qilamiz.

$\mu^s(s=0,1,\ldots)$ parametrlar oldidagi koeffitsientlarni tenglashtirib,

$$\left[B_0(t)-k^2(t)E\right]g_s(t)=0, s=-2,-1, \qquad (13)$$

$$\left[B_0(t)-k^2(t)E\right]g_s(t)=-\sum_{r=1}^{\left[\frac{s}{2}\right]}B_2(t)g_{s-2r}(t)+¿\left[1-\left\{\frac{s}{2}\right\}\right]f_{\left[\frac{s}{2}\right]}(t),¿$$

$$s=0,1,\ldots,h-1, \qquad (14)$$

$$\left[B_0(t)-k^2(t)E\right]g_s(t)=-\sum_{r=1}^{\left[\frac{s}{2}\right]}B_2(t)g_{s-2r}(t)-¿i\left[2k(t)g'_{s-h}(t)++k'(t)g_{s-h}(t)\right]+\left[1-\left\{\frac{s}{2}\right\}\right]f_{\left[\frac{s}{2}\right]}(t), s=h,h+1,\ldots,$$

(15)

$$\left[B_0(t)-k^2(t)E\right]g_s(t)=\left[1-\left\{\frac{s}{2}\right\}\right]f_{\left[\frac{s}{2}\right]}(t)-g''_{s-2h}(t)-i\left[2k(t)g'_{s-h}(t)++k'(t)g_{s-h}(t)\right]-\sum_{r=1}^{\left[\frac{s}{2}\right]}B_2(t)g_{s-2r}(t), s=2h,2$$

(16)

bunda $\left\{\frac{s}{2}\right\},\frac{s}{2}$ soning butun qismi.

$$p_s(t)=T^{-1}_{(t)}g_s(t), s=-2,-1,\ldots,$$

$$\widetilde{f_{\left[\frac{s}{2}\right]}}(t)=T^{-1}_{(t)}f_{\left[\frac{s}{2}\right]}(t), s=0,1,\ldots, \qquad (17)$$

vektorlarni kiritamiz.

U holda (16) va (17) larga asosan (13) – tenglamani s=-2 bo`lganda

$$\left[\wedge(t)-k^2(t)E\right]p_{-2}(t)=0 \qquad (18)$$

ko`rinishda yozamiz.

(18) tenglama n ta tenglamaga yoyiladi:

$$\left[\widetilde{\lambda}_j(t)-\lambda_1(t)\right]p_{-2j}(t)=0,\ j=\overline{1,n} \qquad (19)$$

Bu tenglamadan (19) shartga asosan

$$p_{-2j}(t)=0,\ j=\overline{2,n} \qquad (20)$$

ni aniqlaymiz. p_{-2} vektorning $p_{-21}(t)$ koordinatasi ixtiyoriy aniqlanmagan, uni s=0 bo`lganda (20) tenglamadan aniqlaymiz.

S=-1 bo`lganda (13) tenglamadan

$$\left[\widetilde{\lambda}_j(t)-\lambda_1(t)\right]p_{-1j}(t)=0,\ j=\overline{1,n} \qquad (21)$$

ni aniqlaymiz. (2.54) tenglamadan (2.53) tenglamaga asosan

$$p_{-1j}(t)\equiv 0,\ j=\overline{2,n} \qquad (22)$$

$p_{-1}(t)$ vektorning $p_{-11}(t)$ koordinatasi hozircha aniqlanmagan. U s=0 bo`lganda (22) tenglamadan aniqlanadi.

S=0 bo`lganda (15) tenglamadan

$$\left[\Lambda(t)-\lambda_1(t)E\right]p_0(t)=C(t)p_{-2}(t)+\widetilde{f}_0(t), \qquad (23)$$

bunda

$$C(t)=T^{-1}(t)B_1(t)T(t) \qquad (24)$$

(24) tenglamani koordinat ko`rinishida yozsak

$$\left[\lambda_j(t)-\lambda_1(t)\right]P_{0j}(t)=C_{j1}(t)P_{-21}(t)+\widetilde{f_{0j}}(t),\ j=\overline{1,n} \qquad (25)$$

yoki

$$P_{0j}(t)=\frac{C_{j1}(t)P_{-21}(t)+\widetilde{f_{0j}}(t)}{\lambda_j(t)-\lambda_1(t)},\ j=\overline{2,n} \qquad (26)$$

j=1 bo`lsa (25) tenglamadan

$$C_{11}(t)P_{-21}(t)+\widetilde{f_{01}}(t)=0 \qquad (27)$$

tenglamani aniqlaymiz. (27) tenglamadan $P_{-2}(t)$ vektorning $P_{-21}(t)$ koordinatasini aniqlaymiz. Demak $P_{-2}(t)$ vektor aniqlandi. S=1 bo`lganda (2.47) – tenglamadan $P_{-1}(t)$ vektorni birinchi koordinatasini aniqlaydigan tenglamaga kelamiz va hokazo.

Matematik induksiya metodi asosida (16), (18) va (19) tenglamalardan S=2,3, … bo`lganda hosil qilinadigan tenglamalardan qatorning barcha noma'lum hadlarini aniqlash mumkinligini ko`rsatish mumkin.

Teorema isbotlandi..

FOYDALANILGAN ADABIYOTLAR

1. Метропольский Ю.А. Проблемы асимптотической теории нестационарных колебаний. -М.:Наука, 1964, 432 с.
2. Фещенко С.Ф., Шкиль Н.И., Николенко Л.Д. Асимптотические методы в теории линейных дифференциальных уравнений.- К.: Наукова думка, 1966, 252 с.
3. A. Alishev, Sh. Alishev. Oddiy differensial tenglamalar sistemasini asimptotik integrallash.- T.: "Fan va texnologiya" , 2016, 260 bet.
4. Сотниченко Н.А., Фешенко С.Ф. Асимптотическое интегрирование дифференциальных уравнений. Препринт 80.3. - К.: Ин-т, математики АН Усср, 1980, 48 с.
5. Ломов С.А. Введение в общую теорию сингулярных возмущений. – М.: Наука, 1981, 298 с.