

**O‘ZBEKISTON RESPUBLIKASI OLIY VA O‘RTA MAXSUS
TA‘LIM VAZIRLIGI**

TOSHKENT MOLIYA INSTITUTI

«МАТЕМАТИКА» КАФЕДРАСИ

**«ОЛИЙ МАТЕМАТИКА»
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Toshkent- 2010

18. KVADRATIK FORMALAR

18.1. $L(x_1, x_2, x_3) = 4x_1^2 - 12x_1x_2 - 10x_1x_3 + x_2^2 - 3x_3^2$ kvadratik formaning A matritsasini tuzing.

Kvadratik formaning matritsasini topamiz:

$$L = (x_1 \ x_2 \ x_3) \begin{pmatrix} 4 & -6 & -5 \\ -6 & 1 & 0 \\ -5 & 0 & -3 \end{pmatrix} \begin{pmatrix} x_1 \\ x_2 \\ x_3 \end{pmatrix}, \quad A = \begin{pmatrix} 4 & -6 & -5 \\ -6 & 1 & 0 \\ -5 & 0 & -3 \end{pmatrix}$$

18.2. $L(x_1, x_2) = 2x_1^2 + 4x_1x_2 - 3x_2^2$ kvadratik forma berilgan.

$x_1 = 2y_1 - 3y_2$; $x_2 = y_1 + y_2$; chiziqli almashtirish orqali hosil bo'lgan

$L(y_1, y_2)$ kvadratik formani toping.

Berilgan kvadratik formaning matritsasi $A = \begin{pmatrix} 2 & 2 \\ 2 & -3 \end{pmatrix}$ chiziqli almashtirish

matritsasi $C = \begin{pmatrix} 2 & -3 \\ 1 & 1 \end{pmatrix}$ bo'ladi.

Qidirilayotgan kvadratik formaning matritsasi quyidagicha:

$$A' = C^t \cdot A \cdot C = \begin{pmatrix} 2 & 1 \\ -3 & 1 \end{pmatrix} \begin{pmatrix} 2 & 2 \\ 2 & -3 \end{pmatrix} \begin{pmatrix} 2 & -3 \\ 1 & 1 \end{pmatrix} = \begin{pmatrix} 13 & -17 \\ -17 & 3 \end{pmatrix}$$

kvadratik formaning ko'rinishi:

$$L(y_1, y_2) = 13y_1^2 - 34y_1y_2 + 3y_2^2$$

18.3. Kvadratik formani kanonik ko'rinishga keltiring.

$$L(x_1, x_2, x_3) = x_1^2 - 3x_1x_2 + 4x_1x_3 + 2x_2x_3 + x_3^2 = x_1^2 - x_1(3x_2 - 4x_3) + 2x_2x_3 + x_3^2$$

x_1 o'zgaruvchining kvadrati oldida turgan koeffitsiyenti nol'dan farqli bo'lgani uchun, x_1 o'zgaruvchining to'liq kvadratini topamiz:

$$L = \left[x_1^2 - 2x_1 \left(\frac{1}{2}(3x_2 - 4x_3) \right) + \left(\frac{1}{2}(3x_2 - 4x_3) \right)^2 \right] - \left(\frac{1}{2}(3x_2 - 4x_3) \right)^2 + 2x_2x_3 + x_3^2 = \left(x_1 - \frac{3}{2}x_2 + 2x_3 \right)^2 - \frac{9}{4}x_2^2 + 8x_2x_3 - 3x_3^2$$

endi o'zgaruvchi x_2 uchun kvadratini topamiz:

$$L = \left(x_1 - \frac{3}{2}x_2 + 2x_3 \right)^2 - \frac{9}{4} \left(x_2 - \frac{16}{9}x_3 \right)^2 + \frac{37}{9}x_3^2,$$

Demak, nol'dan farqli chiziqli almashtirish

$$y_1 = x_1 - \frac{3}{2}x_2 - 2x_3$$

$$y_2 = x_2 - \frac{16}{9}x_3$$

$y_3 = y_3$ berilgan kvadratik formani kanonik ko'rinishga keltiradi:

$$L(y_1, y_2, y_3) = y_1^2 - \frac{9}{4}y_2^2 + \frac{37}{9}y_3^2$$

18.4. Kvadratik forma $L = 13x_1^2 - 6x_1x_2 + 5x_2^2$ musbat aniqlangan kvadratik forma ekanligini isbotlang.

Kvadratik formaning matritsasi $A = \begin{pmatrix} 13 & -3 \\ -3 & 5 \end{pmatrix}$ bo'ladi.

Xarakteristik tenglama tuzamiz:

$$|A - \lambda E| = \begin{vmatrix} 13 - \lambda & -3 \\ -3 & 5 - \lambda \end{vmatrix} \text{ yoki } \lambda^2 - 18\lambda + 56 = 0$$

ya'ni $\lambda_1 = 14$, $\lambda_2 = 4$ xarakteristik tenglamaning yechimlari musbat bo'lgani uchun, L -musbat aniqlangan kvadratik forma bo'ladi.

Mustaqil yechish uchun misollar

18.5. Kvadratik formani matritsa ko'rinishida yozing:

$$L = 2x_1^2 + 3x_2^2 - x_3^2 + 4x_1x_2 - 6x_1x_3 + 10x_2x_3$$

18.6. Kvadratik formaning matritsasini toping:

$$L(x_1, x_2, x_3) = (x_1 \ x_2 \ x_3) \begin{pmatrix} -1 & 0 & 2 \\ 2 & 4 & 1 \\ 3 & 0 & -1 \end{pmatrix} \begin{pmatrix} x_1 \\ x_2 \\ x_3 \end{pmatrix}$$

18.7. Kvadratik forma $L(x_1, x_2) = 3x_1^2 - x_2^2 + 4x_1x_2$, berilgan.

$x_1 = 2y_1 - y_2$, $x_2 = y_1 - y_2$, chiziqli almashtirish orqali hosil bo'lgan kvadratik formani toping.

18.8. $x_1^2 + 4x_2^2 + 3x_3^2 + 2x_1x_2$

18.9. $-2x_2^2 - x_1^2 - x_1x_3 + 2x_2x_3 - 2x_3^2$

18.10. $x_1^2 + 26x_2^2 + 10x_1x_2$

Kvadratik formani qanday aniqlanganligini toping:

$$18.11. -x_1^2 + 2x_1x_2 - 4x_2^2$$

$$18.12. x_1^2 + 15x_2^2 + 4x_1x_2 - 2x_1x_3 + 6x_2x_3$$

$$18.13. 12x_1x_2 - 12x_1x_3 + 6x_2x_3 - 11x_1^2 - 6x_2^2 - 6x_3^2$$

$$18.14. x_1^2 + 4x_2^2 + 4x_3^2 + 8x_4^2 + 8x_2x_4$$

Kvadratlik formani kanonik ko'rinishga keltiring:

$$18.15. 3x_2^2 + 3x_3^2 + 4x_1x_2 + 4x_1x_3 - 2x_2x_3$$

$$18.16. 7x_1^2 + 7x_2^2 + 7x_3^2 + 2x_1x_2 + 2x_1x_3 - 2x_2x_3$$

$$18.17. x_1x_2 + x_1x_3 + x_2x_3$$

$$18.18. 17x_1^2 + 14x_2^2 + 14x_3^2 - 4x_1x_2 - 4x_1x_3 - 8x_2x_3$$