KO'PHADLARINI KARRALI KO'PAYTUVCHILARGA AJRATISH

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FarDU o'qituvchisi

Kompleks sonlar maydoni ustida berilgan *f(x)* ko'phadlik uchun

$$f(x)=(x-c)^k\cdot\varphi(x)$$

bo'lib, $\varphi(x) \not\vdots (x-c)$ bo'lsa *s* soni *f(x)* ko'phadlik *k* karrali ildiz deyiladi.

n≥1 darajali *f(x)* ko'phad, *R* sonlar maydoni ustida keltirilmaydigan ko'phadlik bo'lishi uchun $(f(x), f'(x))=1$ bo'lishi zarrur va etarli.

f(x) ning bir karrali ko'paytuvchilarining ko'paytmasini X_1 bilan belgilasak, 2 karrali ko'paytuvchilarining ko'paytmasini esa X_2 va xokazo *S* karrali ko'paytuvchilarining ko'paytmasini X_s bilan belgilasak.

U holda bergan ko'phadlikni

$$f(x)=X_1\cdot X_2^2\cdot X_3^3\cdot X_4^4\cdot X_5^5\cdot\ldots\cdot X_{s-1}^{s-1}\cdot X_s^s \qquad (1)$$

$$f'(x)=X_2^1\cdot X_3^2\cdot X_4^3\cdot X_5^4\cdot\ldots\cdot X_{s-1}^{s-2}\cdot X_s^{s-1}$$

(xosilada darajalari 1 tadan kam kiradi) ko'rinishda yozish mumkin.

$$D(x)=(f,f')=f'=X_2^1\cdot X_3^2\cdot X_4^3\cdot\ldots\cdot X_{s-1}^{s-2}\cdot X_2^{s-1}$$

$$D'(x)=X_3^1\cdot X_4^2\cdot\ldots\cdot X_s^{s-2}$$

bo'ladi.

$$D_1=(D,D')=D'=X_3^1\cdot X_4^2\cdot\ldots\cdot X_s^{s-2}$$

$$D_1'=X_4^1\cdot X_5^2\cdot\ldots\cdot X_s^{s-3}$$

bo'ladi.

$$D_2=(D_1,D_1')=D_1'=X_4^1\cdot\ldots\cdot X_s^{s-3}$$

va xokazo.

$$D_{s-2}=(D_{s-3},D_{s-3}')=D_{s-3}'=X_s'$$

$$D_{s-2}'=1$$

$$D_{s-1}=(D_{s-2},D_{s-2}')=1$$

$$E_1=\frac{f}{D}=X_1\cdot X_2\cdot X_3\cdot\ldots\cdot X_{s-1}\cdot X_s$$

$$E_2=\frac{D}{D_1}=X_2\cdot X_3\cdot X_4\cdot\ldots\cdot X_{s-1}\cdot X_s$$

$$E_3=\frac{D_1}{D_2}=X_3\cdot X_4\cdot\ldots\cdot X_{s-1}\cdot X_s$$

- -

$$E_{s-1}=\frac{D_{s-3}}{D_{s-2}}=X_{s-1}\cdot X_s$$

$$E_s=\frac{D_{s-2}}{D_{2-1}}=X_s$$

$$\frac{E_1}{E_2}=X_1,\quad \frac{E_2}{E_3}=X_2,\ldots,E_3=X_s$$

1-Misol.

$$f(x)=x^6-6x^4-4x^3+9x^2+12x+4$$

$$f'(x)=6x^5-24x^3-12x^2+18x+12$$

$$D=(f,f')=x^4+x^3-3x^2-5x-2$$

$$D'=4x^3+3x^2-6x-5$$

$$D_1=(D,D')=x^2+2x+1$$

$$D_1'=2x+2$$

$$D_2=(D_1,D_1')=x+1$$

$$D_2'=1$$

$$D_3=(D_2,D_2')=1$$

$$E_1=\frac{f}{D}=x^2-x-2$$

$$E_2=\frac{D}{D_1}=\frac{x^4+x^3-3x^2-5x-2}{x^2+2x+1}=x^2-x-2$$

$$E_3=\frac{D_1}{D_2}=\frac{x^2+2x+1}{x+1}=x+1$$

$$E_4=\frac{D_3}{D_2}=x+1$$

$$X_1=\frac{E_1}{E_2}=1;\quad X_2=\frac{E_2}{E_3}=x-2;\quad X_3=\frac{E_3}{E_4}=1$$

$$X_4=E_4=x+1$$

Javob:

$$f(x)=X_1\cdot X_2^2-X_3^3\cdot X_4^4=1\cdot(x-2)^2-1^3\cdot(x+1)^4=(x-2)^2(x+1)^4$$

2-misol.

$$f(x)=x^6-15x^4+8x^3+51x^2-72x+27$$

ko‘phadni karrali ko‘paytiuvchilarga ajrating.

Yechish: *f(x)* ni karrali ko‘paytuvchilarga ajratish uchun dastlab, $f'(x)$ ni topamiz

$$f'(x)=6x^5-60x^3+24x^2+102x-72$$

Endi *f(x)* va $f'(x)$ ko‘phadlarning EKUBin topamiz. $D_1(f(x);f'(x))$ - ?

Buning uchun *f(x)* ni $f'(x)$ ga bo‘lamiz

$$\begin{array}{l|l}
6\cdot x^6-15x^4+8x^3+51x^2-72x+27 & \underline{6x^5-60x^3+24x^2+102x-72} \\
-\ 6x^6-90x^4+48x^3+306x^2-432x+162 & x \\
\underline{6x^6-60x^4+24x^3+102x^2-72x} &
\end{array}$$

$$-30x^4+24x^3+204x^2-360x+162/:(-6)$$

$$-5x^4-4x^3-34x^2+60x-27$$

f(x) ni $f'(x)$ ga bo‘lganda bo‘linma *x* va qoldiq $r(x)=5x^4-4x^3-34x^2+60x-27$ bo‘ldi. Endi $f'(x)$ ni *r(x)* ga bo‘lib, $r_1(x)$ qoldiqni topamiz. Shu tariqa bo‘luvchini qoldiqqa bo‘lish jarayonini davom ettirib, $r_n(x)=0$ bo‘lguncha jarayonni davom ettiramiz. Berilgan ko‘phadlarning EKUBi o‘zgarmas son ko‘paytmasi aniqligida yagona ekanligini tasdiqlovchi teoremaga asosan, bo‘lish jarayonida o‘zimizga qulaylik yaratish maqsadida ko‘phadlarni yoki qoldiqlarni biror noldan farqli songa ko‘paytirishimiz yoki bo‘lishimiz mumkin bo‘ladi.

$$\begin{array}{l|l}
\frac{5}{6}\cdot/6x^5-60x^3+24x+102x-72 & \underline{5x^4-4x^3-34x^2+60x-27} \\
-\quad 5x^5-50x^3+20x^2+85x-60 & x+4 \\
\underline{5x^5-4x^4-34x^3+60x^2-27x} &
\end{array}$$

$$5\cdot/4x^4-16x^3-40x^2+112x-60$$

$$20x^4-80x^3-200x^2+560x-300$$

$$-\ \underline{20x^4-16x^3-136c^2+240x-108}$$

$$-64x^3-64x^2+320x-192/:(-64)$$

$$\begin{array}{r|l} -\begin{array}{l}5x^4-4x^3-4x^2+60x-27\\ 5x^4+5x^3-25x^2+15x\end{array} & \begin{array}{l}x^3+x^2-5x+3\\ \hline 5x-9\end{array} \\ \hline -9x^3-9x^2+45x-27 & \\ -9x^3-9x^2+45x-27 & \\ \hline 0 & \end{array}$$

Demak, $D_1(x)=(f(x);\ f'(x))=x^3+x^2-5x+3$ ekan. Endi *D₁(x)* ning $D_1'(x)$ xosilasini topamiz

$$D_1'(x)=3x^2+2x-5$$

Undan so‘ng $D_1(x)$ va $D_1'(x)$ ko‘phadlarning EKUBini topamiz $D_2(x)=(D_1(x);\ D_1'(x))-?$

$$\begin{array}{l|l} 3\cdot/x^3+x^2-5x+3 & \\ 3x^3+3x^2-15x+9 & \begin{array}{l}3x^2+2x+5\\ \hline x+1\end{array} \\ 3x^3+2x^2-5x & \\ \hline 3\cdot/x^2-10x+9 & \\ -3x^2-30x+27 & \\ 3x^2+2x-5 & \\ \hline -32x+32/:(-32) & \end{array}$$

$$\begin{array}{r|l} -\begin{array}{l}3x^2+2x-5\\ 3x^2-3x\end{array} & \begin{array}{l}x-1\\ \hline 3x+5\end{array} \\ \hline 5x-5 & \\ -5x-5 & \\ \hline 0 & \end{array}$$

Demak, $D_2(x)=(D_1(x);\ D_1'(x))=x-1$ hosil bo‘ladi. Endi $D_2(x)$ ko‘phadning hosilasi $D_2'(x)$ ni topamiz.

$$D_2'(x)=(x-1)'=1$$

U holda, $D_3(x)=(D_2(x);D_2'(x))=1$ bo‘ladi. Bu jarayon $D_i(x)$ va $D_i'(x)$ larni EKUBi 1 bo‘lguncha davom etadi.

Endi, $E_1(x)=\dfrac{f(x)}{D_1(x)}$ ni topamiz.

$$
\begin{array}{l|l}
-\dfrac{x^6 = 15x^4 + 8x^3 + 51x^2 - 72x + 27}{x^6 + x^5 - 5x^4 + 3x^2} & \dfrac{x^3 + x^2 - 5x + 3}{x^3 - x^2 - 9x + 9}
\end{array}
$$

$$
\begin{array}{r}
-\dfrac{-x^5 - 10x^4 + 5x^3 + 51x^2}{-x^5 - x^4 + 5x^3 - 3x^2} \\
-9x^4 + 54x^2 - 72x \\
\underline{-9x^2 - 9x^3 + 45x^2 - 27x} \\
- \quad 9x^3 + 9x^2 - 45x + 27 \\
-\underline{9x^3 + 9x^2 - 45x + 27} \\
0
\end{array}
$$

$$E_1(x) = \frac{f(x)}{D_1(x)} = x^3 - x^2 - 9x + 9$$

Undan so‘ng $E_2(x) = \dfrac{D_1(x)}{D_2(x)}$ ni topamiz.

$$
\begin{array}{l|l}
-\dfrac{x^3 + x^2 - 5x + 3}{x^3 - x^2} & \dfrac{x - 1}{x^2 + 2x - 3}
\end{array}
$$

$$
\begin{array}{r}
2x^2 - 5x + 3 \\
\underline{2x^2 - 2x} \\
- \quad -3x + 3 \\
-\underline{-3x + 3} \\
0
\end{array}
$$

Demak,

$$E_2(x) = \frac{D_1(x)}{D_2(x)} = x^2 + 2x - 3$$

hosil bo‘ldi.

Endi, $E_3(x) = \dfrac{D_2(x)}{D_3(x)}$ ni topamiz

$$E_3(x) = \frac{x - 1}{1} = x - 1$$

Shunday qilib, karrali ildizlarni topishga kirishamiz.

$X_1 = \dfrac{E_1(x)}{E_2(x)}$ ni topamiz X_1 ikkihad berilgan *f(x)* ko‘phad tarkibida birinchi daraja bilan qatnashadi

$$X_1 = \frac{x^3 - x^2 - 9x + 9}{x^2 + 2x - 3} = x - 3$$

Shuning uchun $x_1=3$ *f(x)* koʻphad uchun bir karrali ildizi boʻladi

$$X_2 = \frac{E_2(x)}{E_3(x)} = \frac{x^2 + 2x - 3}{x - 1} = x + 3$$

X_2 ikkihad berilgan *f(x)* koʻphad tarkibida ikkinchi daraja bilan qatnashadi. Shuning uchun $x_2 = -3$ son *f(x)* koʻphadning ikki karrali ildizi hisoblanadi.

$$X_3 = E_3(x) = x - 1$$

X_3 ikkihad berilgan *f(x)* koʻphad tarkibida 3-daraja bilan qatnashadi. Chunki $x_3=1$ son *f(x)* koʻphad uchun uch karrali ildiz boʻladi.

Shunday qilib, berilgan *f(x)* koʻphadni karrali ildizlarini topib, uni karrali koʻpaytuvchilarga ajratdik. Natijada berilgan *f(x)* koʻphad

$$f(x) = (x-3) \cdot (x+3)^2 \cdot (x-1)^3$$

koʻrinishidagi karrali koʻpaytuvchilarga ajratildi.

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