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FUNKSIONAL TENGLAMALAR VA ULARNI YECHISH USULLARI

Nargiza Tosheva Ahmedovna
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Buxoro davlat universiteti

Anatatsiya: Bu tezisda funksional tenglamalarni o'zgaruvchilarni almashtirish usuli yordamida tenglamalarni yechish o'rganilgan va misollar keltirilgan.

Tayanch so'zlar: To'plam, funksiya, uzluksiz funksiya, funksional, elementar funksional, funksional tenglama

Funksional tenglama — noma'lumi funksiya bo'lib keladigan har qanday [tenglama](#). Ko'pincha, tenglama funksiyaning (yoki funksiylarning) bir nuqtadagi qiymatini boshqa nuqtalardagi qiymatlari bilan bog'laydi. Masalan, funksiylarning qiymatlarini ular qanoatlantiradigan funksional tenglamalarning turlarini ko'rib chiqish orqali aniqlash mumkin. *Funksional tenglama* atamasi odatda [algebraik tenglamalar](#) yoki [differensial tenglamalarga](#) keltirish mumkin bo'lmagan tenglamalarni anglatadi.

Funksiyalardan tashkil topgan to'plamga funksional to'plam deyiladi. $[a, b]$ kesmada aniqlangan barcha uzluksiz funksiylar to'plami, $[a, b]$ kesmada aniqlangan barcha chegaralangan funksiylar to'plami funksional to'plamlarga misol bo'la oladi.

Funksional tenglamalar mos ravishda

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

tenglamalardan iborat. Shu kabi

$$f(x) = f\left(\frac{x}{2}\right); \quad f(x) = \cos\left(\frac{1}{2}\right) f\left(\frac{x}{2}\right),$$

f — uzluksiz funksiya. Bu tenglamalar bir o'zgaruvchili funksional tenglamalarga misol bo'ladi. Ikki o'zgaruvchili

$$\begin{aligned} f(x+y) &= f(x) + f(y) & f(x+y) &= f(x)f(y) \\ f(xy) &= f(x) + f(y) & f(xy) &= f(x)f(y) \end{aligned}$$

funksional tenglamalar Koshi tenglamalari deyiladi.

Funksional tenglamalar ko'plab matematik turnir va olimpiadalarda berilib, bu funksional tenglamalarni qanoatlantiruvchi funksiylarni topish talab qilinadi. Umuman aytganda funksional tenglamalarni yechishning traditsion usullari mavjud bo'lmasdan balki har bir olingan tenglamaga alohida qarash lozim bo'ladi.

1-misol. Agar

$$f(x) + 2f\left(\frac{1}{x}\right) = x; \tag{1}$$

tenglik o'rinli bo'lsa u holda $f(x)$ funksiyaning toping.

Yechilishi. Bu tenglamani yechish uchun $x \rightarrow \frac{1}{x}$ almashtirish bajarilsa berilgan tenglama

$$f\left(\frac{1}{x}\right) + 2f(x) = \frac{1}{x}; \tag{2}$$

ko'rinishga keladi . (2) tenglamani -2 ga ko'paytirib (1) tenglamaga qo'shilsa $3f(x) = \frac{2}{x} - x$ tenglikni hosil qilamiz. Bundan $f(x) = \frac{2}{3x} - \frac{x}{3}$ natijani hosil qilamiz.

2-misol: Barcha $x, y \in R$ lar uchun

$$f(x + y) = x + yf(x) + (1 - x)y \quad (3)$$

tenglamani qanoatlantiruvchi funksiyani toping.

Yechilishi $f(x)$ funksiya barcha $x, y \in R$ lar uchun (3) tenglamani qanoatlantirsin. Agar (3) tenglamada $y = 0$ bo'lsa, u holda $f(x) = x$ bo'lib, bu funksiya berilgan tenglamani qanoatlantiradi, chunki

$$x + yf(x) + (1 - x)y = x + xy + (1 - x)y = x + y = f(x + y)$$

Demak: $f(x) = x$

Foydalanilgan adabiyot.

1. Kin Y.Li, Functional equations // Mathematical Excalibur, 2003, V8, No 1, p.5.

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