TAQQOSLAMALAR .EYLER FUNKSIYASI.

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ABSTRACT
Maqolada Taqqoslamalar ularning xosslari o’rganilgan.Taqqoslamalarni Eyler va Ferma teoremalari orqali o’rganish.

Z-butun sonlar halqasi bo`lib, $m\geq 1$ natural son bo`lsin. Ta`rif. Agar Z halqaga tegishli a va b sonlarni m natural songa bo`lganda hosil bo`lgan qoldiqlar bir xil bo`lsa, yoki a-b ayirma m ga bo`linsa, yoki a=b+mq tenglik o`rinli bo`lsa, u holda a va b sonlar m modul bo`yicha taqqoslanadi deyiladi va uni $a\equiv b(\mathrm{mod}\ m)$ ko`rinishda belgilanadi.

Taqqoslamalar quyidagi xossalarga ega:

1^0. Taqqoslama ekvivalent binar munosabat.

2^0.Bir xil modulli taqqoslamalarni hadma-had qo`shish (ayirish) mumkin. Bu ish n ta $a_1\equiv b_1(\mathrm{mod}\ m)$, $a_2\equiv b_2(\mathrm{mod}\ m)$,...,$a_n\equiv b_n$ (mod m) taqqoslamalar uchun ham bajariladi, ya`ni $a_1\pm a_2\pm...\pm a_n\equiv(b_1\pm b_2\pm...\pm b_n)$ (mod m) taqqoslamani hosil qilamiz.

Natija. Taqqoslamaning bir qismidagi sonni uning ikkinchi qismiga qarama-qarshi ishora bilan o`tkazish mumkin.

Natija. Taqqoslamaning ixtiyoriy qismiga modulga karrali sonni qo`shish mumkin.

3^0. Bir xil modulli taqqoslamalarni hadma-had ko`paytirish mumkin.

Natija. Taqqoslamaning ikki qismini (modulni o`zgartirmay) bir xil natural darajaga ko`tarish mumkin.

4^0. Modulni o`zgartirmagan holda taqqoslamaning ikki qismini bir xil butun songa ko`paytirish mumkin.

5^0.Agar $x\equiv y(\mathrm{mod}\ m)$ bo`lsa, u holda ixtiyoriy butun koeffitsientli $f(x)=a_0x^n+a_1x^{n-1}+...+a_{n-1}x+a_n$, $f(y)=a_0y^n+a_1y^{n-1}+...+a_{n-1}y+a_n$ ko`phadlar uchun $f(x)=f(y)$ (mod m) taqqoslama o`rinli bo`ladi.

6^0.Agar bir vaqtda $a_i=b_i$ (mod m)($i=\overline{1,n}$) va x= y (mod m) taqqoslamalar o`rinli bo`lsa, u holda

$a_0 x^n+a_1 x^{n-1}+...+a_{n-1}x+a_n = b_0 y^n + b_1 y^{n-1} +...+b_{n-1} y+b_n (mod\ m)$ taqqoslama o`rinli bo`ladi.

Natija. Taqqoslamada qatnashuvchi qo`shiluvchini o`zi bilan teng qoldiqli bo`lgan ikkinchi songa almashtirish mumkin.

7^0. Taqqoslamaning ikki qismini modul bilan o`zaro tub bo`lgan ko`paytuvchiga qisqartirish mumkin.

8^0. Taqqoslamaning ikki qismini va modulini bir xil musbat songa ko`paytirish, taqqoslamaning ikki qismi va moduli umumiy ko`paytuvchiga ega bo`lsa, u xolda bu taqqoslamaning ikki qismi va modulini bu umumiy ko`paytuvchiga bo`lish mumkin.

9^0. Agar taqqoslama bir necha Modul bo`yicha o`rinli bo`lsa, u holda bu taqqoslama shu modullarning eng kichik umumiy bo`linuvchisi bo`yicha ham o`rinli bo`ladi.

10^0. Agar taqqoslama biror m Modul bo`yicha o`rinli bo`lsa, u holda bu takdoslama modulning ixtiyoriy buluvchisi buyicha ham o`rinli bo`ladi.

11^0. Taqqoslamaning bir qismi va modulining EKUB bilan uning ikkinchi qismi va modulining EKUB o`zaro teng bo`ladi.

Barcha butun sonlarni m≥l natural songa bo`lganda 0, 1, 2, ..., m-1 qoldiqlar hosil bo`ladi. Bunday h*ar* bir qoldiqqa butun sonlarning biror sinfi mos keladi.

Ta`rif. m ga bo`linganda r ga teng bir xil qoldiq beradigan butun sonlar to`plami m modul bo`yicha chegirmalar sinflari deyiladi va uni $\bar{r}$ kabi belgilanadi.

Ta`rif. Chegirmalar sinfining ixtiyoriy elementi shu sinfning chegirmasi deyiladi.

Ta`rif. m Modul bo`yicha tuzilgan har bir chegirmalar sinfidan erkinlik bilan bittadan element olib tuzilgan to`plamga m Modul bo`yicha chegirmalarning to`la sistemasi deyiladi.

Sinfning bitta chegirmasi m Modul bilan o`zaro tub bo`lsa, u holda bu sinfning barcha elementlari ham m Modul bilan o`zaro tub bo`ladi.

Ta`rif. m Modul bilan o`zaro tub bo`lgan barcha chegirmalar sinfidan erkinlik bilan bittadan chegirma olib tuzilgan to`plam chegirmalarning m Modul bo`yicha keltirilgan sistemasi deyiladi.

m modul bo`yicha chegirmalarning keltirilgan sistemasidagi elementlar sonini aniqlash uchun Eyler funktsiyasi deb ataluvchi φ(m) funksiyadan foydalanamiz.

Ta`rif. Agar quyidagi ikkita shart bajarilsa, u holda φ(m) sonli funktsiya Eyler funktsiyasi deyiladi:

1. φ(1)=1.

2. φ(m) funktsiya m dan kichik va m bilan o`zaro tub bo`lgan natural sonlar soni.

Ta`rif. Natural sonlar to`plamida aniqlangan f funktsiya uchun (m; n)=1 bo`lganda f(m·n)=f(m)·f(n) tenglik bajarilsa, u holda f funktsiyaga mul`tiplikativ funktsiya deyiladi.

Teorema. Eyler funktsiyasi mul`tiplikativ funktsiya bo`ladi.φ(m) Eyler funksiyasini hisoblash formulalari quyidagilardan iborat: m=p tub son bo`lsa, u holda φ(p)=r-1 bo`ladi.

m= r^{α} (r-tub son, α-natural son) bo`lsa, u holda $\varphi(p^{\alpha})=p^{\alpha-1}\cdot(p-1)$ bo`ladi.

m= $p_1^{\alpha_1} p_2^{\alpha_2} ... p_k^{\alpha_k}$ bo`lsa, u holda

$$\varphi(m) = \varphi\left(p_1^{\alpha_1} p_2^{\alpha_2} ... p_k^{\alpha_k}\right) = m\left(1-\frac{1}{p_1}\right)\left(1-\frac{1}{p_2}\right)...\left(1-\frac{1}{p_k}\right)$$

o`ladi.

Eyler teoremasi. Agar (a; m)=1 bo`lsa, u holda $a^{\varphi(m)}\equiv 1(\mathrm{mod}\ m)$ taqqoslama o`rinli bo`ladi.

Ferma teoremasi. Agar a son r tub songa bo`linmasa, u holda $a^{p-1}\equiv 1$ (mod m) taqqoslama o`rinli bo`ladi.

Koeffitsientlari butun sonlardan iborat $f(x)= a_0 x^n+ +a_1\cdot \cdot x^{n-1}$ ...$a_{n-1}x+a_n$ ko`phad berilgan bo`lsin.

Ta`rif. Ushbu

$f(x)\equiv 0(\mathrm{mod}\ m)$ (a_0 son m ga bo`linmaydi, $a_i\in Z$, $m\geq 1$) (1)

ko`rinishdagi taqqoslamani bir noma`lumli n- darajali taqqoslama deyiladi.

Ta`rif. Agar x=s bo`lganda

$$f(c)\equiv 0(\mathrm{mod}\ m) \qquad (2)$$

taqqoslama to`g`ri bo`lsa, u holda s son (1) taqqoslamani qanoatlantiradi deyiladi.

Teorema. Agar s son (1) taqqoslamani qanoatlantirsa, u holda $\bar{c}$ chegirmalar sinfiga tegishli ixtiyoriy son ham (1) taqqoslamani qanoatlantiradi.

Ta`rif. Agar s son (1) taqqoslamani qanoatlantirsa, u holda $\bar{c}$ chegirmalar sinfi (1) taqqoslamaning echimi deyiladi.

m modul bo`yicha barcha chegirmalar sinfi $\bar{0},\bar{1},\bar{2},...,\overline{m-1}$ bo`ladi. Demak, m modulli taqqoslamani qanoatlantiruvchi sonlarni 0,1,2,..., m-1 sonlar ichidan qidirish lozim.

Ta`rif. Yechimlari to`plami ustma-ust tushgan taqqoslamalarni teng kuchli taqqoslamalar deyiladi.

Agar (1) taqqoslamaning ikki qismiga ixtiyoriy ko`phad qo`shilsa yoki har ikki qismini m Modul bilan o`zaro tub bo`lgan k songa ko`paytirilsa, yoki ikki qismi va modulini k natural songa ko`paytirilsa, u holda hosil bo`lgan taqqoslama berilgan taqqoslamaga teng kuchli bo`ladi.

Ta`rif. Ushbu $ax\equiv b(\mathrm{mod}\ m)$ $(a,b\in Z,\forall m\in N)$ (3)

ko`rinishdagi taqqoslamaga bir noma`lumli birinchi darajali taqqoslama deyiladi.

Teorema. Agar (a;m)=1 bo`lsa, u holda (3) taqqoslama yagona echimga ega bo`ladi.

Teorema. Agar (a; m)=d bo`lib, b son d ga bo`linmasa, u holda (3) taqqoslama echimga ega emas.

Teorema. Agar (3) taqqoslamada (a; m)=d bo`lib, b son d ga bo`linsa, u holda (3) taqqoslama soni d ga teng bo`lgan ushbu

$$\bar{\alpha},\ \overline{\alpha+\frac{m}{d}},\ldots,\overline{\alpha+\frac{(d-1)m}{d}} \qquad (5)$$

echimlarga ega bo`lib, bundagi $\alpha$ echim $\frac{a}{d}x\equiv\frac{b}{a}(\mathrm{mod}\ \frac{m}{d})$ taqqoslamaning yagona echimi bo`ladi.

Ta`rif. Agar $f(x) = a_0x^p+a_1x^{n-1}$ +...+$a_{n-1}$ $x+a_n$ ,$a_i\in Z$, r-tub son, $a_0$con r ga bo`linmasa, u holda ushbu

$$f(x)\equiv 0(\mathrm{mod}\ p) \qquad (6)$$

taqqoslamaga tub modulli p-darajali bir nomat`lumli taqqoslama deyiladi.

Teorema. Agar (6) taqqoslamada a_0 bosh koeffitsient r ga bo`linmasa, u holda (6) taqqoslama bosh koeffitsienti 1 ga teng bo`lgan boshqa bir taqqoslamaga teng kuchli bo`ladi.

Teorema. Agar f(x) va g(x) koeffitsientlari butun sonlardan iborat ko`phadlar bo`lsa, u holda

$$f(x) \equiv 0 (\text{mod } p), \quad (7)$$

$$f(x)-(x^p-x)g(x) \equiv 0 (\text{mod} p) \quad (8)$$

taqqoslamalar teng kuchli bo`ladi.

Teorema. Darajasi n (n>r) bo`lgan r tub modulli taqqoslama darajasi r-1 dan katta bo`lmagan taqqoslamaga teng kuchli bo`ladi.

Teorema. Tub modulli n-darajali taqqoslama echimlari soni n tadan ortiq emas.

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