INTEGRAL. BOSHLANGICH FUNKSIYA. ANIKMAS INTEGRAL VA UNING XOSSASI. ASOSIY FORMULALAR JADVALI

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Annotatsiya: Maqolada “Integral. Boshlangich funksiya. Anikmas integral va uning xossasi. Asosiy formulalar jadvali ” “Bumerang” texnologiyasi yordamida o`qitish usuli yoritilgan. Bumerang texnologiyasi turli mazmun va harakaterga (muommoli,munozarali, turli mazmunli)ega bo`lgan mavzularni o`rganishda qulay bo`lib, o`z ichiga og`zaki va yozma ish shaklilarini qamrab oladi, hamda bir mashg`ulot davomida har bir mashg`ulot davomida har bir ishtirokchininfg turli topshiriqlarni bajarishi navbat bilan talaba yoki o`qituvchi rolida bo`lishi, kerakli ballni to`plashiga imkon beradi. Talabalarni mashg`ulot jarayonida darsdan tashqarida turli adabiyotlar, matnlar bilan ishlash, o`rganilgan materialni yodida saqlab qolish, so`zlab berish fikrini aniq bayon eta olish hamda bir dars davomida talabalarni baholay olishga qaratilgan.

**Kalit so`zlar:** Integral, boshlang`ich funksiya, aniqmas integral, dars, talaba, o`qituvchi, mavzu, baholash, guruh, o`quv material.

Abstract: In the article "Integral. Initial function. Anikmas integral and its property. The table of basic formulas” The method of teaching with the help of "Boomerang" technology is explained. Boomerang technology is convenient for learning topics with different content and movement (problematic, controversial, different content) and includes oral and written forms of work. and during one session, during each session, each participant performs different tasks, alternately in the role of a student or a teacher, and allows him to collect the necessary points. During the training, students are directed to work with various literatures and texts outside of class, to keep the learned material in mind, to be able to express their thoughts clearly, and to be able to evaluate students during one lesson.

1. Boshlangich funksiya. Aniqmas integral va uning xossasi.

y-f(x) funksmya (a, v) integralda berilgan bulsin.

F(x) esa shu oralikdadifferensiallanuvchi funksmya bulsin.

1-Ta’rif. Agar F(x) funksiyaning xosilasi F`(x) berilgan f(x) funksiyaga teng bo`lsa, F` ( x ) = f ( x ) yoki d F(x)=f(x) dx bo`lsa, u holda F(x) funksiya f(x) funksiyaning boshlang`ich funksiyasi deb ataladi.

Misolllar: 1. $F(x) = x^2$ bo`lsin. Bu funksiyaning boshlangich funksiyasi

$\overline{F(x)} = \frac{1}{3}x^3 + c$ bo`ladi.

2. f (x) = cosx bo`lsin. Bu funksiyaning boshlang`ich funksiyasi F(x) = Sinx bo`ladi, chunki $F`(x) = (sinx)` = cosx = f(x)$

Agar f(x) funksiya (a, b) da uzluksiz bo`lsa, u holda bu funksiya shu oraliqda boshlang`ich funksiyaga ega bo`ladi. f(x) funksiya ( a, b ) da berilgan bo`lib, u shu oraliqda ikkita F(x) va F(x) boshlang`ich funksiyalariga ega bo`lsin.

Ta’rifga binoan $F`(x) = f(x)$ , $F`(x) = f(x)$ bo`ladi.

Demak, $F`(x) = f(x)$ , u holda yuqorida keltirilgan natijaga ko`ra F(x) va F(x) funksiyalar bir-biridan o`zgarmas songa farq qiladi.

f(x)=F(x)+C (C -const)

Demak, berilgan f(x) funksiyaning boshlang`ich funksiyalari cheksiz ko`p bo`lib, ular bir-biridan o`zgarmas songa farq qiladi. Agar F(x) funksiya f(x) funksiyaning boshlang`ich funksiya bo`lsa, unda f(x) ning istalgan funksiyasi

F(x) +C (C-const) ko`rinishda bo`ladi.

2-ta’rif: Agar F(x) funksiya f(x) funksiyaning boshlangich funksiyasi bulsa, u xolda F(x) +C ifoda f(x) funksiyaning anikmas integrali deyiladi va ∫f(x) dx kabi belgilanib,

∫f(x)dx=F(x)+C, (C-c’nst) ko`rinishda yoziladi.

Bu yerda f(x) – integral ostidagi funksiya

F(x) dx – integral ostidagi ifoda

∫ - integral belgisi

x – integralning uzgaruvchisi

f(x) – oshlangich funksiyasini topish amali funksiyani integrallash deyiladi .

Aniqmas integralning xossalari.

1. Aniqmas integralning hosilasi integral ostidagi funksiyaga tengdir

(∫f(x) dx) = f(x)

2. Aniqmas integralning differensiali integral ostidagi ifodaga tengdir:

d∫f(x) dx = f(x) dx

1va2 xossalar aniqmas integral ta’rifidan kelib chikadi.

3. Funksiya differensialining aniqmas integrali u funksiyadagi ixtiyoriy o`zgarmasni qo`shilganiga tengdir ∫ d[F(x)] = F(x) + C

Isbot: ∫d[F(x)] = ∫ F’(x) dx + C

4. O`zgarmas ko`paytuvchini integral belgisi oldiga chiqarish mumkin, ya’ni ∫ a f (x) dx = a ∫ f(x) dx

Isbot: integral ta’rifiga asosan

[∫ a f(x) dx]’ = a f(x)

Ikkinchi tomondan [a ∫ f(x)dx]’ = a[∫ f(x) dx]’ = af(x)

Shunday qilib ∫ af(x) dx = a∫ f(x)dx

5. Bir nechta funksiyaning algebraik yig`indisidan olingan aniqmas integral shu funksiyalardan olingan integrallarning algebraik yig`indisiga teng, ya’ni

∫ [f_1(x) + f_2 (x) – f_3 (x)] dx = ∫f_1 (x) dx - ∫f_2(x) dx - ∫f_3 (x) dx

Isbot : ta’rifga asosan

$(\int[f_1(x) + f_2(x) - f_3(x)]\,dx)' = f_1(x) + f_2(x) - f_3(x)$

Ikkinchi tomondan $(\int[f_1(x)dx + \int f_2(x)dx - \int f_3(x)dx' =$

$= (\int f_1(x)\,dx)' + (\int f_2(x)\,dx)' - (\int f_3(x)\,dx)' = f_1(x) + f_2(x) - f_3(x)$

Natija. X o`zgaruvchidan boshqa u o`zgaruvchiga o`tilganda integral ko`rinishi o`zgarmaydi, ya’ni

$\int f(x)\,dx = F(x)+C$

$\int f(u)du = F(u) + C$

Asosiy integrallar jadvali.

I. $\int x^m\,dx = \dfrac{x^{m+1}}{m+1} + C \quad (m \neq -1)$

II. $\int dx/x = \ln|x| + C \quad x \neq 0$

III. $\int \sin x\,dx = -\cos x + C$

IV. $\int \cos x\,dx = \sin x + C$

V. $\int a^x dx = \dfrac{a^x}{\ln a} + C$

VI. $\int e^x\,dx = e^x + C$

VII. $\int dx/\cos^2 x = \operatorname{tg} x + C$

VIII. $\int dx/\sin^2 x = -\operatorname{ctg} x + C$

IX. $\int dx/(1+x^2) = \operatorname{arctg} x + C$

X. $\int \dfrac{dx}{\sqrt{1-x^2}} = \arcsin x + C$

XI. $\int \operatorname{tg} x\,dx = -\ln|\cos x| + C$

XII. $\int \operatorname{ctg} x\,dx = \ln|\sin x| + C$

$$\text{XIII.} \int \frac{dx}{a^2+x^2} = \frac{1}{a}\operatorname{arctg}\frac{x}{a} + C$$

$$\text{XIV.} \int \frac{dx}{\sqrt{a^2-x^2}} = \arcsin\frac{x}{a} + C$$

$$\text{XV.} \int \frac{dx}{\sqrt{x^2 \pm a^2}} = \ln|x+\sqrt{x^2 \pm a^2}| + C$$

$$\text{XVI.} \int \frac{dx}{x^2 \pm a^2} = \frac{1}{2a}\ln\left|\frac{a+x}{a-x}\right| + C$$

Bu integrallardan birining, masalan $\int \frac{dx}{a^2+x^2} = \frac{1}{a} arctg\frac{x}{a} + c$

to`g`riligini ko`ramiz.

Integrallash usullari.

1. Bevosita integrallash usuli.
2. Differensial belgisi ostiga kiritish usuli.

$x = \varphi(u)$, $dx = \varphi'(u)\,du$ deb olsak

$\int f(x)\,dx = \int f[\varphi(u)]\,\varphi' du$ buladi

Bunday usul o`zgaruvchini almashtirish usuli deb ataladi. Sodda xollarda integral belgisi ostidagi differensial ifodani kuyida kursatilganidek:

$dx = (1/a)\,d(ax+b)$; $2xdx = d(x^2)$ $\cos x\,dx = d(\sin x)$ $dx/x = d(lnx)$

va shunga o`xshash almashtirib va kavslar ichidagi ifodalarni u deb faraz qilish asosida yangi o`zgaruvchi u ni kiritish amalini ko`ngilda bajarish tavsiya qilinadi.

Bu usul bilan integrallash bevosita integrallash deyiladi.

1-misol: $\int \frac{dx}{1+9x^2} = \frac{1}{3}\int \frac{d(1+(3x)^2}{1+(3x)^2} = \frac{1}{3} arctg3x + c$

Bo`laklab integrallash.

Bu usul ikki funksiyaning ko`paytmasini differensiallash formulasidan kelib chiqadi. Faraz qilaylik, u(x) va v(x) –x ning differensiallanuvchi funksiyalari bo`lsin. Bu funksiyalar ko`paytmasining differensialini topamiz:

$d(uv) = v\,du + u\,dv$

bundan udv = d (u v) – vdu

Oxirgi tenglikning ikkala qismini integrallab, quyidagini topamiz:

∫udv = ∫d(uv) - ∫vdu yoki ∫udv = uv - ∫vdu

Bu formula bo`laklab integrallash formulasi deyiladi.

Ushbu I $\int x^m \sin x\,dx$; $\int x^m \cos x\,dx$; $\int x^m e^x\,dx$

Tipidagi integrallar uchun $x^m = u$

qolgan ko`paytuvchilar =dv belgilash qulaydir

II $\int x^m \ln x\,dx$; $\int x^m \arccos x\,dx$; $\int x^m \arccos x\,dx$;

$\int x^m \operatorname{arctg} x\,dx$; $\int x^m \operatorname{arcctg} x\,dx$;

tipidagi integrallar uchun

transsendent ko`paytuvchi qolgan kupaytuvchilar = } = u dv deb belgilash qulaydir.

III. $\int e^{ax} \sin bx\,dx$; $\int e^{ax} \cos bx\,dx$

Tipidagi integrallar uchun

$e^{ax} = u$ kolgan kupaytuvchilar } = dv deb olish kulaydir.

lnx = u du = dx/x

Misol: ∫lnx dx = | = | = xlnx -∫x • (1/x) dx=xlnx-∫dx=xlnx-x+C

dx = dv v=x

Xulosa:Demak, integrallashni bo`laklab ishlash mumkin. Integrallashning usullari bevosita integrallash usuli va differensial belgisi ostiga kiritish usullari mavjud. Aniqmas integrallash jadvali asosida misollar bajariladi.

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