

"Системы линейных
уравнений"

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1УБТ(2)

№2.1.32.

$$\begin{cases} x_1 - x_2 = 1 \\ 2x_1 - 2x_2 = 5 \end{cases}$$

$$\left(\begin{array}{cc|c} 1 & -1 & 1 \\ 2 & -2 & 5 \end{array} \right) \xrightarrow{\text{II} - 2\text{I}} \left(\begin{array}{cc|c} 1 & -1 & 1 \\ 0 & 0 & 3 \end{array} \right) \Rightarrow$$

$\Rightarrow r(A) \neq r(A|B) \Rightarrow$ сист. несовм.

№2.1.33

$$\begin{cases} 3x + 2y = 5 \\ 6x + 4y = 10 \end{cases}$$

$$\left(\begin{array}{cc|c} 3 & 2 & 5 \\ 6 & 4 & 10 \end{array} \right) \xrightarrow{\text{II} - 2\text{I}} \left(\begin{array}{cc|c} 3 & 2 & 5 \\ 0 & 0 & 0 \end{array} \right) \Rightarrow$$

$\Rightarrow r(A) = r(A|B) = 1, n=2 \Rightarrow$

\Rightarrow сист. совм. и неопр.

$$3x + 2y = 5$$

$\exists y - \text{cb. neb., T.K. } |3| = 3 \neq 0$

$$3x = 5 - 2y$$

$$x = \frac{5}{3} - \frac{2}{3}y$$

①

$\exists y = t$, torga ošus. p-ue:

$$\boxed{\left(\frac{5}{3} - \frac{2t}{3}; t \right)}$$

$\exists t = \frac{5}{2}$, torga react. p-ue:

$$\boxed{\left(\frac{5}{3} - 2, \frac{5}{2} \right)}$$

$\exists t = 1$, torga react. p-ue:

$$\boxed{\left(1; 1 \right)}$$

Wd. 1. 34.

$$\begin{cases} x_1 + 2x_2 = 3 \\ -2x_1 + 3x_2 = 0 \\ -2x_1 - 4x_2 = 1 \end{cases}$$

$$\left(\begin{array}{cc|c} 1 & 2 & 3 \\ -2 & 3 & 0 \\ -2 & -4 & 1 \end{array} \right) \xrightarrow{\text{II}+2\text{I}} \sim \xrightarrow{\text{III}+2\text{I}}$$

$$\sim \left(\begin{array}{cc|c} 1 & 2 & 3 \\ 0 & 7 & 6 \\ 0 & 0 & 7 \end{array} \right) \Rightarrow \text{r}(A) \neq \text{r}(A|B) \Rightarrow$$

\Rightarrow cuc7. necobs.

②

Wd. 1.35

$$\left\{ \begin{array}{l} x - \sqrt{3}y = 1 \\ \sqrt{3}x - 3y = \sqrt{3} \\ -\frac{\sqrt{3}}{3}x + y = -\frac{\sqrt{3}}{3} \end{array} \right.$$

$$\left(\begin{array}{cc|c} 1 & -\sqrt{3} & 1 \\ \sqrt{3} & -3 & \sqrt{3} \\ -\frac{\sqrt{3}}{3} & 1 & -\frac{\sqrt{3}}{3} \end{array} \right) \xrightarrow{\text{II} - \sqrt{3}\text{I}} \sim \left(\begin{array}{cc|c} 1 & -\sqrt{3} & 1 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{array} \right)$$

$$\sim \left(\begin{array}{cc|c} 1 & -\sqrt{3} & 1 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{array} \right) \Rightarrow r(A) = r(A|B) = 1,$$

$n=2$, \Leftrightarrow unst. Lsg. u. negat.

$$x - \sqrt{3}y = 1$$

$$|1| = 1 \neq 0 \Rightarrow y - \text{ab. neg.}$$

$$x = 1 + \sqrt{3}y$$

$$y = t, \text{ ergo } \underbrace{x}_{\boxed{1 + \sqrt{3}t}} = t$$

③

$\exists t = \frac{\sqrt{3}}{3}$, torga exact. p-ue:

$$\left(\frac{1}{2}; \frac{\sqrt{3}}{3} \right)$$

w2.1. 36.

$$\begin{cases} 3x - y = -5 \\ 2x + 3y = 4 \\ -x + \frac{1}{3}y = \frac{5}{3} \\ x + 1,5y = 2 \end{cases}$$

$$\sim \left(\begin{array}{ccc|c} 3 & -1 & -5 \\ 2 & 3 & 4 \\ -1 & \frac{1}{3} & \frac{5}{3} \\ 1 & 1,5 & 2 \end{array} \right) \quad I \leftrightarrow IV \sim$$

$$\sim \left(\begin{array}{ccc|c} 1 & 1,5 & 2 \\ 2 & 3 & 4 \\ -1 & \frac{1}{3} & \frac{5}{3} \\ 3 & -1 & -5 \end{array} \right) \quad \begin{matrix} II - 2I \\ III + I \\ IV - 3I \end{matrix} \sim$$

④

"система линейных уравнений"

№ 2.1.36 (неподжемное)

$$\sim \left(\begin{array}{cc|c} 1 & 1,5 & 2 \\ 0 & 0 & 0 \\ 0 & \frac{11}{6} & \frac{11}{3} \\ 0 & -\frac{11}{2} & -11 \end{array} \right) \cdot \frac{3}{11} \cdot \left(-\frac{1}{11} \right)$$

Task
НВТ түрбесі,
3 нөгөр.

$$\sim \left(\begin{array}{cc|c} 1 & \frac{3}{2} & 2 \\ 0 & 0 & 0 \\ 0 & \frac{1}{3} & 1 \\ 0 & \frac{1}{2} & 1 \end{array} \right) \xrightarrow{\text{II} \leftrightarrow \text{IV}}$$

$$\sim \left(\begin{array}{cc|c} 1 & \frac{3}{2} & 2 \\ 0 & \frac{1}{2} & 1 \\ 0 & \frac{1}{3} & 1 \\ 0 & 0 & 0 \end{array} \right) \xrightarrow{\text{I} \leftrightarrow \text{II}}$$

$$\left(\begin{array}{cc|c} 1 & \frac{3}{2} & 2 \\ 0 & \frac{1}{2} & 1 \\ 0 & 0 & \frac{1}{6} \\ 0 & 0 & 0 \end{array} \right)$$

$$\Rightarrow r(A) \neq r(A|B) \Rightarrow$$

сист. решеб.

(5)

Wk. 1.3 #

$$\begin{cases} 3x + 4y + 2z = 8 \\ 2x - 4y - 3z = -1 \\ x + 5y + z = 0 \end{cases}$$

$$\left(\begin{array}{ccc|c} 3 & 4 & 2 & 8 \\ 2 & -4 & -3 & -1 \\ 1 & 5 & 1 & 0 \end{array} \right) \xrightarrow{\text{III} \leftrightarrow \text{I}} \sim$$

$$\sim \left(\begin{array}{ccc|c} 1 & 5 & 1 & 0 \\ 2 & -4 & -3 & -1 \\ 3 & 4 & 2 & 8 \end{array} \right) \xrightarrow{\text{II} - 2\text{I}} \sim \quad \text{III} - 3\text{I}$$

$$\sim \left(\begin{array}{ccc|c} 1 & 5 & 1 & 0 \\ 0 & -14 & -5 & -1 \\ 0 & -11 & -1 & 8 \end{array} \right) \xrightarrow{-14\text{III} + 11\text{II}} \sim$$

$$\sim \left(\begin{array}{ccc|c} 1 & 5 & 1 & 0 \\ 0 & -14 & -5 & -1 \\ 0 & 0 & -41 & -123 \end{array} \right) \xrightarrow{\cdot (-1)} \sim \quad \cdot -\frac{1}{41}$$

$$(⑥) \sim \left(\begin{array}{ccc|c} 1 & 5 & 1 & 0 \\ 0 & +14 & +5 & +1 \\ 0 & 0 & 1 & 3 \end{array} \right) \Rightarrow$$

$$\Rightarrow r(A) = r(A|B) = 3, n = 3 \Rightarrow$$

zur. cest. obec. u. dph.

$$\begin{cases} x + 5y + z = 0 \\ 4x + 5z = 1 \\ z = 3 \end{cases}$$

$$\begin{cases} x = 2 \\ y = -1 \\ z = 3 \end{cases} \Rightarrow \boxed{\text{odys. u. zact. p-ue!} \quad (2; -1; 3)}$$

W2.1.38

$$\begin{cases} -x + y - 3z = 5 \\ 3x - y - z = 2 \\ 2x + y - 9z = 0 \end{cases}$$

$$\left(\begin{array}{ccc|c} -1 & 1 & -3 & 5 \\ 3 & -1 & -1 & 2 \\ 2 & 1 & -9 & 0 \end{array} \right) \xrightarrow{\text{II} + 3\text{I}} \sim \xrightarrow{\text{III} + 2\text{I}}$$

$$\sim \left(\begin{array}{ccc|c} -1 & 1 & -3 & 5 \\ 0 & 2 & -10 & 17 \\ 0 & 3 & -15 & 10 \end{array} \right) \xrightarrow[1]{2\text{I} - 3\text{II}} \sim$$

⑦

$$\sim \left(\begin{array}{ccc|c} -1 & 1 & -3 & 5 \\ 0 & 2 & -10 & 17 \\ 0 & 0 & 0 & -31 \end{array} \right) \Rightarrow$$

$\Rightarrow r(A) \neq r(A|B) \Rightarrow$ сист. несовм

в.д. 1.39

$$\left\{ \begin{array}{l} 2x - y - z = 0 \\ 3x + 4y - 2z = 0 \\ 3x - 2y + 4z = 0 \end{array} \right.$$

$$\sim \left(\begin{array}{ccc|c} 2 & -1 & -1 & 0 \\ 3 & 4 & -2 & 0 \\ 3 & -2 & 4 & 0 \end{array} \right) \left. \begin{array}{l} 2\text{II}-3\text{I} \\ 2\text{III}-3\text{I} \end{array} \right\} \sim$$

$$\sim \left(\begin{array}{ccc|c} 2 & -1 & -1 & 0 \\ 0 & 11 & -1 & 0 \\ 0 & -1 & 11 & 0 \end{array} \right) \left. \begin{array}{l} \text{III}+\text{II}\text{III} \\ \cancel{\text{I}} \cancel{\text{II}} \cancel{\text{III}} \end{array} \right\} \sim$$

$$\sim \left(\begin{array}{ccc|c} 2 & -1 & -1 & 0 \\ 0 & 1 & -1 & 0 \\ 0 & 0 & 11 & 0 \end{array} \right) \left. \begin{array}{l} \text{II} \leftrightarrow \text{III} \end{array} \right\} \sim$$

$$\textcircled{3} \sim \left(\begin{array}{ccc|cc} 2 & -1 & -1 & 0 & 0 \\ 0 & 1 & -1 & 0 & 0 \\ 0 & 0 & 11 & 0 & 0 \end{array} \right) \Rightarrow$$

"Система алгебраических уравнений"

Тема
Единица

№ 2. 39 (упрощение)

УБТ
Лекция
Задачи

$$\Rightarrow n(A) = n(A \setminus B) = 3, n = 3 \Rightarrow$$

з) сист. собл. и общ.

$$\begin{cases} 2x - y - z = 0 \\ -y + 11z = 0 \\ 120z = 0 \end{cases}$$

$$\begin{cases} 2x - y - z = 0 \\ y = 11z \\ z = 0 \end{cases}$$

$$\begin{cases} 2x - y - z = 0 \\ y = 0 \\ z = 0 \end{cases}$$

$$\begin{cases} x = 0 \\ y = 0 \\ z = 0 \end{cases} \Rightarrow$$

Одн. и рабт. п-ки:
(0; 0; 0)

№ 2. 40

$$\begin{cases} 3x + y - 5z = 0 \\ x - 2y - z = 0 \\ 2x + 3y - 4z = 0 \\ x + 5y - 3z = 0 \end{cases}$$

9

$$\sim \left(\begin{array}{ccc|c} 3 & 1 & -5 & 0 \\ 1 & -2 & -1 & 0 \\ 2 & 3 & -4 & 0 \\ 1 & 5 & -3 & 0 \end{array} \right) \xrightarrow{\text{II} \leftrightarrow \text{I}} \sim$$

$$\sim \left(\begin{array}{ccc|c} 1 & -2 & -1 & 0 \\ 3 & 1 & -5 & 0 \\ 2 & 3 & -4 & 0 \\ 1 & 5 & -3 & 0 \end{array} \right) \xrightarrow{\text{II} - 3\text{I}} \sim \xrightarrow{\text{III} - 2\text{I}} \sim \xrightarrow{\text{IV} - \text{I}}$$

$$\sim \left(\begin{array}{ccc|c} 1 & -2 & -1 & 0 \\ 0 & 7 & -2 & 0 \\ 0 & 7 & -2 & 0 \\ 0 & 7 & -2 & 0 \end{array} \right) \xrightarrow{\text{III} - \text{II}} \sim \xrightarrow{\text{IV} - \text{II}}$$

$$\sim \left(\begin{array}{ccc|c} 1 & -2 & -1 & 0 \\ 0 & 7 & -2 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \end{array} \right) \Rightarrow$$

$$\Rightarrow r(A) = r(A|B) = 2, n=3 \Rightarrow$$

(10) Cvet. cabil. u rešenju.

$$\begin{vmatrix} 1 & -2 \\ 0 & 7 \end{vmatrix} = 7 \neq 0 \Rightarrow \text{2-obj. nep.}$$

$$\begin{cases} x - 2y - z = 0 \\ 7y - 2z = 0 \end{cases}$$

$$\begin{cases} x - 2y - z = 0 \\ y = \frac{2}{7}z \end{cases}$$

$$\begin{cases} x - 2y - z = 0 \\ 7y = 2z \end{cases}$$

$$\begin{cases} x = \frac{11}{7}z \\ y = \frac{2}{7}z \end{cases}$$

$\left\{ \begin{array}{l} \frac{2}{7}z = t, \text{ torga obj. f-ue:} \\ \left(\frac{11}{7}t; \frac{2}{7}t; t \right) \end{array} \right.$

$\left\{ \begin{array}{l} z = 7t, \text{ torga obj. f-ue:} \\ (11t; 2t; 7t) \end{array} \right.$

$\left\{ \begin{array}{l} t = 1, \text{ torga obj. f-ue:} \\ (11; 2; 7) \end{array} \right.$

wL. 1.41

$$\begin{cases} 3x_1 + 2x_2 + x_3 = 5 \\ 2x_1 + 3x_2 + x_3 = 1 \\ 2x_1 + x_2 + 3x_3 = 11 \\ 3x_1 + 4x_2 - x_3 = -5 \end{cases}$$

10
2

;

11

$$\left(\begin{array}{ccc|c} 3 & 2 & 1 & 5 \\ 2 & 3 & 1 & 1 \\ 2 & 1 & 3 & 11 \\ 3 & 4 & -1 & -5 \end{array} \right) \xrightarrow{3\text{II}-2\text{I}} \left(\begin{array}{ccc|c} 3 & 2 & 1 & 5 \\ 0 & 1 & -2 & -4 \\ 2 & 1 & 3 & 11 \\ 3 & 4 & -1 & -5 \end{array} \right) \xrightarrow{3\text{III}-2\text{I}} \left(\begin{array}{ccc|c} 3 & 2 & 1 & 5 \\ 0 & 1 & -2 & -4 \\ 0 & -1 & 7 & 22 \\ 3 & 4 & -1 & -5 \end{array} \right) \xrightarrow{\text{IV}-\text{I}} \left(\begin{array}{ccc|c} 3 & 2 & 1 & 5 \\ 0 & 1 & -2 & -4 \\ 0 & -1 & 7 & 22 \\ 0 & 2 & -2 & -10 \end{array} \right)$$

\sim

$$\sim \left(\begin{array}{ccc|c} 3 & 2 & 1 & 5 \\ 0 & 1 & -2 & -4 \\ 0 & -1 & 7 & 22 \\ 0 & 2 & -2 & -10 \end{array} \right) \xrightarrow{\cdot \frac{1}{2}} \left(\begin{array}{ccc|c} 3 & 2 & 1 & 5 \\ 0 & 1 & -2 & -4 \\ 0 & -1 & 7 & 22 \\ 0 & 1 & -1 & -5 \end{array} \right)$$

\sim

$$\sim \left(\begin{array}{ccc|c} 3 & 2 & 1 & 5 \\ 0 & 1 & -2 & -4 \\ 0 & -1 & 7 & 22 \\ 0 & 1 & -1 & -5 \end{array} \right) \xrightarrow{5\text{III}+\text{II}} \left(\begin{array}{ccc|c} 3 & 2 & 1 & 5 \\ 0 & 1 & -2 & -4 \\ 0 & 0 & 6 & 27 \\ 0 & 1 & -1 & -5 \end{array} \right) \xrightarrow{5\text{IV}-\text{II}} \left(\begin{array}{ccc|c} 3 & 2 & 1 & 5 \\ 0 & 1 & -2 & -4 \\ 0 & 0 & 6 & 27 \\ 0 & 0 & -6 & -47 \end{array} \right)$$

\sim

$$\sim \left(\begin{array}{ccc|c} 3 & 2 & 1 & 5 \\ 0 & 1 & -2 & -4 \\ 0 & 0 & 6 & 27 \\ 0 & 0 & -6 & -47 \end{array} \right) \xrightarrow{6\text{I}+\text{III}} \left(\begin{array}{ccc|c} 3 & 2 & 1 & 5 \\ 0 & 1 & -2 & -4 \\ 0 & 0 & 12 & 54 \\ 0 & 0 & -6 & -47 \end{array} \right)$$

\sim

$$\textcircled{(2)} \quad \sim \left(\begin{array}{ccc|c} 3 & 2 & 1 & 5 \\ 0 & 1 & -2 & -4 \\ 0 & 0 & 12 & 54 \\ 0 & 0 & 0 & -179 \end{array} \right) \Rightarrow \text{r}(A) \neq \text{r}(A|B) \Rightarrow \text{сист. несовм.}$$

"Система линейных
уравнений"

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УБТ, 1к,
3нр.

wd. 1.42

$$\begin{cases} 2\sqrt{5}x_1 - x_2 + \sqrt{5}x_3 = 1 \\ 10x_1 - \sqrt{5}x_2 + 5x_3 = \sqrt{5} \\ -2x_1 + \frac{\sqrt{5}}{5}x_2 - x_3 = -\frac{1}{\sqrt{5}} \end{cases}$$

$$\left(\begin{array}{ccc|c} 2\sqrt{5} & -1 & \sqrt{5} & 1 \\ 10 & -\sqrt{5} & 5 & \sqrt{5} \\ -2 & \frac{\sqrt{5}}{5} & -1 & -\frac{1}{\sqrt{5}} \end{array} \right) \cdot \frac{1}{\sqrt{5}}$$

$$\left(\begin{array}{ccc|c} 2 & -1 & \cancel{\sqrt{5}} & 1 \\ 10 & \cancel{-\sqrt{5}} & 5 & \cancel{\sqrt{5}} \\ -2 & \cancel{\frac{\sqrt{5}}{5}} & -1 & \cancel{-\frac{1}{\sqrt{5}}} \end{array} \right) \xrightarrow{\text{II} - 5\text{I}} \left(\begin{array}{ccc|c} 2 & -1 & 0 & 1 \\ 0 & 0 & 0 & 0 \\ -2 & -\frac{\sqrt{5}}{5} & -1 & 0 \end{array} \right) \xrightarrow{\text{III} + \text{I}}$$

$$\left(\begin{array}{ccc|c} 2 & -1 & 1 & \frac{\sqrt{5}}{5} \\ 0 & 0 & 0 & 0 \\ -2 & -\frac{\sqrt{5}}{5} & -1 & -\frac{\sqrt{5}}{5} \end{array} \right) \xrightarrow{\text{II} - 5\text{I}} \left(\begin{array}{ccc|c} 2 & -1 & 1 & \frac{\sqrt{5}}{5} \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \end{array} \right)$$

(13)

$$\sim \left(\begin{array}{ccc|c} 2 & -\frac{\sqrt{5}}{5} & 1 & \frac{\sqrt{5}}{5} \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \end{array} \right) \Rightarrow$$

$$\Rightarrow r(A) = r(A|B) = 1, n=3 \Rightarrow$$

2) CUCI. COBL. U' neomf.

$$|A|=1 \neq 0 \Rightarrow x_1 x_2 - c.b. \text{ nep.}$$

$$2x_1 - \frac{\sqrt{5}}{5} x_2 + x_3 = \frac{\sqrt{5}}{5}$$

$$x_3 = \frac{\sqrt{5}}{5} - 2x_1 + \frac{\sqrt{5}}{5} x_2$$

3) $x_1 = t_1, x_2 = t_2$, torga oðguf-ue:

$$\boxed{(t_1; t_2; \frac{\sqrt{5}}{5} - 2t_1 + \frac{\sqrt{5}}{5} t_2)}$$

3) $t_1 = 0, t_2 = -1$, torga raci. f-ue:

$$\boxed{(0; -1; 0)}$$

(14)

W2.1.43

$$\begin{cases} 3x_1 + 4x_2 + x_3 + 2x_4 = 3 \\ 6x_1 + 8x_2 + 2x_3 + 5x_4 = 7 \\ 9x_1 + 12x_2 + 3x_3 + 10x_4 = 13 \end{cases}$$

$$\sim \left(\begin{array}{cccc|c} 3 & 4 & 1 & 2 & 3 \\ 6 & 8 & 2 & 5 & 7 \\ 9 & 12 & 3 & 10 & 13 \end{array} \right) \begin{matrix} \text{II} - 2\text{I} \\ \text{III} - 3\text{I} \end{matrix} \sim$$
$$\sim \left(\begin{array}{cccc|c} 3 & 4 & 1 & 2 & 3 \\ 0 & 0 & 0 & 1 & 1 \\ 0 & 0 & 0 & 4 & 4 \end{array} \right) \begin{matrix} \text{III} - 4\text{II} \end{matrix} \sim$$
$$\sim \left(\begin{array}{cccc|c} 3 & 4 & 1 & 2 & 3 \\ 0 & 0 & 0 & 1 & 1 \\ 0 & 0 & 0 & 0 & 0 \end{array} \right) \Rightarrow$$

$$\Rightarrow r(A) = r(A|B) = 2, n=4 \Rightarrow$$

zur cuest. obige u. neup.

$$\left| \begin{array}{cc} 1 & 2 \\ 0 & 1 \end{array} \right| = 1 \neq 0 \Rightarrow x_1, x_2 - \text{ob. neph.}$$

(5)

$$\begin{cases} 3x_1 + 4x_2 + x_3 + 2x_4 = 3 \\ x_4 \geq 1 \end{cases}$$

$$\begin{cases} x_3 = 1 - 3x_1 - 4x_2 \\ x_4 = 1 \end{cases}$$

$\exists x_1 = t_1, x_2 = t_2$, тогда связ. п-ве:

$$(t_1; t_2; 1 - 3t_1 - 4t_2; 1)$$

$\exists t_1 = \frac{1}{3}, t_2 = -\frac{1}{4}$, тогда

важ. п-ве:

$$\left(\frac{1}{3}; -\frac{1}{4}; 1; 1 \right)$$

вд. 1.44

(16) $\begin{cases} 2x_1 + x_2 + 3x_4 = 4 \\ x_1 + x_2 - 2x_3 = 0 \\ 5x_1 + x_3 - x_4 = 2 \\ 2x_1 + x_3 + x_4 = 3 \\ x_1 + x_2 + 4x_3 - 3x_4 = -3 \end{cases}$

Система линейных
уравнений

№ 2. 1. 44 (продолжение)

ЕИКИНГ
Таня
УВТ 1к,
3 №.

$$\sim \left(\begin{array}{ccccc} 2 & 1 & 0 & 3 & 4 \\ 1 & 1 & -2 & 0 & 0 \\ 3 & 0 & 1 & -1 & 2 \\ 2 & 0 & 1 & 1 & 3 \\ 1 & 1 & 4 & -3 & -3 \end{array} \right) \quad \text{II} \leftrightarrow \text{I} \sim$$

$$\sim \left(\begin{array}{ccccc} 1 & 1 & -2 & 0 & 0 \\ 2 & 1 & 0 & 3 & 4 \\ 3 & 0 & 1 & -1 & 2 \\ 2 & 0 & 1 & 1 & 3 \\ 1 & 1 & 4 & -3 & -3 \end{array} \right) \quad \text{II} - 2\text{I} \sim$$

$$\sim \left(\begin{array}{ccccc} 1 & 1 & -2 & 0 & 0 \\ 0 & -1 & 2 & 3 & 4 \\ 3 & 0 & 1 & -1 & 2 \\ 2 & 0 & 1 & 1 & 3 \\ 1 & 1 & 4 & -3 & -3 \end{array} \right) \quad \text{III} - 3\text{I} \sim$$

$$\sim \left(\begin{array}{ccccc} 1 & 1 & -2 & 0 & 0 \\ 0 & -1 & 2 & 3 & 4 \\ 0 & -3 & 7 & -1 & 2 \\ 2 & 0 & 1 & 1 & 3 \\ 1 & 1 & 4 & -3 & -3 \end{array} \right) \quad \text{IV} - 2\text{I} \sim$$

$$\sim \left(\begin{array}{ccccc} 1 & 1 & -2 & 0 & 0 \\ 0 & -1 & 2 & 3 & 4 \\ 0 & -3 & 7 & -1 & 2 \\ 0 & -2 & 5 & 1 & 3 \\ 0 & 0 & 6 & -3 & -3 \end{array} \right) \quad \text{III} - 3\text{II} \sim$$

$$\sim \left(\begin{array}{ccccc} 1 & 1 & -2 & 0 & 0 \\ 0 & -1 & 2 & 3 & 4 \\ 0 & 0 & 1 & 8 & 2 \\ 0 & 0 & 5 & 1 & 3 \\ 0 & 0 & 6 & -3 & -3 \end{array} \right) \quad \text{IV} - 2\text{II} \sim$$

(17)

$$\sim \left(\begin{array}{cccc|c} 1 & 1 & -2 & 0 & 0 \\ 0 & -1 & 4 & 3 & 4 \\ 0 & 0 & -5 & -10 & -40 \\ 0 & 0 & -3 & -5 & -5 \\ 0 & 0 & 6 & -3 & -3 \end{array} \right) \xrightarrow{\begin{pmatrix} 1 \\ 5 \\ 1-1 \end{pmatrix}} \sim$$

$$\sim \left(\begin{array}{cccc|c} 1 & 1 & -2 & 0 & 0 \\ 0 & -1 & 4 & 3 & 4 \\ 0 & 0 & 1 & 2 & 2 \\ 0 & 0 & +3 & 5 & 5 \\ 0 & 0 & 6 & -3 & -3 \end{array} \right) \xrightarrow{\text{IV} - 3\text{II}} \sim \xrightarrow{\text{V} - 6\text{II}}$$

$$\sim \left(\begin{array}{cccc|c} 1 & 1 & -2 & 0 & 0 \\ 0 & -1 & 4 & 3 & 4 \\ 0 & 0 & 1 & 2 & 2 \\ 0 & 0 & 0 & -1 & -1 \\ 0 & 0 & 0 & -15 & -15 \end{array} \right) \xrightarrow{\cdot(-1)} \sim \xrightarrow{\cdot(-1) \rightarrow \text{V} - 15\text{I}}$$

(18)

$$\left(\begin{array}{cccc|c} 1 & 1 & -2 & 0 & 0 \\ 0 & -1 & 4 & 3 & 4 \\ 0 & 0 & 1 & 2 & 2 \\ 0 & 0 & 0 & 1 & 1 \\ 0 & 0 & 0 & 0 & 0 \end{array} \right) \Rightarrow$$

$$\Rightarrow r(A) = r(A|B) = 4, n=4 \Rightarrow$$

~~сост. та сист. симм н опр.~~

~~4*1 - 2*0~~

$$\begin{cases} x_1 + x_2 - 2x_3 = 0 \\ -x_2 + 4x_3 + 3x_4 = 4 \\ x_3 + 2x_4 = 2 \\ x_4 = 1 \end{cases}$$

$$\begin{cases} x_1 + x_2 - 2x_3 = 0 \\ -x_2 + 4x_3 + 3x_4 = 4 \\ x_3 = 0 \\ x_4 = 1 \end{cases}$$

$$\begin{cases} x_1 = -x_2 + 2x_3 \quad \cancel{+ 2x_3} \\ x_2 = -1 \\ x_3 = 0 \\ x_4 = 1 \end{cases}$$

$$\begin{cases} x_1 = 1 \\ x_2 = -1 \\ x_3 = 0 \\ x_4 = 1 \end{cases} \Rightarrow \boxed{\text{симм. и рабт. п-ие: } (1; -1; 0; 1)}$$

(19)

W2.1.45

$$\begin{cases} 45x_1 - 28x_2 + 34x_3 - 52x_4 = 9 \\ 36x_1 - 23x_2 + 29x_3 - 43x_4 = 3 \\ 35x_1 - 21x_2 + 28x_3 - 45x_4 = 16 \\ 47x_1 - 32x_2 + 36x_3 - 48x_4 = -17 \\ 27x_1 - 19x_2 + 22x_3 - 35x_4 = 6 \end{cases}$$

$$\left(\begin{array}{ccccc} 45 & -28 & 34 & -52 & 9 \\ 36 & -23 & 29 & -43 & 3 \\ 35 & -21 & 28 & -45 & 16 \\ 47 & -32 & 36 & -48 & -17 \\ 27 & -19 & 22 & -35 & 6 \end{array} \right) \xrightarrow{\begin{matrix} 5\text{II}-4\text{I} \\ 9\text{III}-7\text{I} \\ 43\text{IV}-47\text{I} \\ 5\text{V}-3\text{I} \end{matrix}} \sim$$

$$\sim \left(\begin{array}{ccccc} 45 & -28 & 34 & -52 & 9 \\ 0 & -3 & 9 & -7 & -21 \\ 0 & \cancel{-28} & \cancel{49} & \cancel{-64} & \cancel{81} \\ 0 & -124 & 22 & 284 & -1188 \\ 0 & -11 & 8 & -19 & 3 \end{array} \right) \xrightarrow{\begin{matrix} 3\text{II}+7\text{I} \\ 3\text{IV}-124\text{II} \\ 3\text{V}-11\text{II} \end{matrix}} \sim$$

$$\sim \left(\begin{array}{ccccc} 45 & -28 & 34 & -52 & 9 \\ 0 & -3 & 9 & -7 & -21 \\ 0 & 0 & 105 & -172 & 96 \\ 0 & 0 & -1050 & 1720 & -960 \\ 0 & 0 & -75 & 20 & 240 \end{array} \right) \xrightarrow{\begin{matrix} \text{IV}+10\text{III} \\ 7\text{V}+5\text{III} \end{matrix}} \sim$$

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№ 2.1.45 (продолжение)

$$\sim \left(\begin{array}{cccc|c} 45 & -28 & 34 & -52 & 9 \\ 0 & -3 & 9 & -7 & -21 \\ 0 & 0 & 105 & -172 & 96 \\ 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & -720 & 2160 \end{array} \right) \quad \text{IV} \leftrightarrow \text{V}$$

$$\sim \left(\begin{array}{cccc|c} 45 & -28 & 34 & -52 & 9 \\ 0 & -3 & 9 & -7 & -21 \\ 0 & 0 & 105 & -172 & 96 \\ 0 & 0 & 0 & -720 & 2160 \\ 0 & 0 & 0 & 0 & 0 \end{array} \right) \quad \rightarrow$$

$\Rightarrow r(A) = r(A|B) = 4, n = 4 \Rightarrow$

\Rightarrow сист. общ. и опр.

$$\left\{ \begin{array}{l} 45x_1 - 28x_2 + 34x_3 - 52x_4 = 9 \\ -3x_2 + 9x_3 - 7x_4 = -21 \\ 105x_3 - 172x_4 = 96 \\ -720x_4 = 2160 \end{array} \right.$$

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$$\left\{ \begin{array}{l} 45x_1 - 28x_2 + 34x_3 - 52x_4 = 9 \\ -3x_2 + 9x_3 - 7x_4 = -11 \\ 605x_3 - 172x_4 = 96 \\ x_4 = -3 \end{array} \right.$$

$$\left\{ \begin{array}{l} 45x_1 - 28x_2 + 34x_3 = -147 \\ -3x_2 + 9x_3 = -42 \\ x_3 = -4 \\ x_4 = -3 \end{array} \right.$$

$$\left\{ \begin{array}{l} 45x_1 - 28x_2 = -11 \\ x_2 = 1 \\ x_3 = -4 \\ x_4 = -3 \end{array} \right.$$

$$\left\{ \begin{array}{l} x_1 = 1 \\ x_2 = 2 \\ +x_3 = -4 \\ x_4 = -3 \end{array} \right. \Rightarrow \boxed{\text{odn. u ract. p-ue: } (1; 2; -4; -3)}$$

✓ 1.8.96

(2)(2)

W2.1.46

$$\begin{cases} 6x_1 + 4x_2 + 5x_3 + 2x_4 + 3x_5 = 1 \\ 3x_1 + 2x_2 + 4x_3 + x_4 + 2x_5 = 3 \\ 3x_1 + 2x_2 - 2x_3 + x_4 = -7 \\ 9x_1 + 6x_2 + x_3 + 3x_4 + 2x_5 = 2 \end{cases}$$

$$\sim \left(\begin{array}{ccccc|c} 6 & 4 & 5 & 2 & 3 & 1 \\ 3 & 2 & 4 & 1 & 2 & 3 \\ 3 & 2 & -2 & 1 & 0 & -7 \\ 9 & 6 & 1 & 3 & 2 & 2 \end{array} \right) \xrightarrow{\text{III} \leftrightarrow \text{I}} \sim$$
$$\sim \left(\begin{array}{ccccc|c} 3 & 2 & -2 & 1 & 0 & -7 \\ 3 & 2 & 4 & 1 & 2 & 3 \\ 6 & 4 & 5 & 2 & 3 & 1 \\ 9 & 6 & 1 & 3 & 2 & 2 \end{array} \right) \xrightarrow{\text{II} - \text{I}} \sim$$
$$\sim \left(\begin{array}{ccccc|c} 3 & 2 & -2 & 1 & 0 & -7 \\ 0 & 0 & 6 & 0 & 2 & 10 \\ 0 & 0 & 9 & 0 & 3 & 15 \\ 0 & 0 & 7 & 0 & 2 & 23 \end{array} \right) \xrightarrow[6\text{II} - 7\text{I}]{2\text{III} - 3\text{II}} \sim$$

\$\therefore\$

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$$\sim \left(\begin{array}{ccccc|c} 3 & 2 & -2 & 1 & 0 & -7 \\ 0 & 0 & 6 & 0 & 2 & 10 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & -2 & 68 \end{array} \right) \xrightarrow{\text{II} \leftrightarrow \text{IV}} \sim$$

$$\sim \left(\begin{array}{ccccc|c} 3 & 2 & -2 & 1 & 0 & -7 \\ 0 & 0 & 6 & 0 & 2 & 10 \\ 0 & 0 & 0 & 0 & -2 & 68 \\ 0 & 0 & 0 & 0 & 0 & 0 \end{array} \right) \Rightarrow$$

$$\Rightarrow r(A) = r(A|B) = 3, n=5 \Rightarrow$$

⇒ C.M.C. eoball. u. reonp.

$$\left\{ \begin{array}{l} 3x_1 + 2x_2 - 2x_3 + x_4 = -7 \\ 6x_3 + 2x_5 = 10 \\ -2x_5 = 68 \end{array} \right.$$

$$\left| \begin{array}{ccc|c} 2 & -2 & 0 & \\ 0 & 6 & 2 & \\ 0 & 0 & -2 & \end{array} \right| \Rightarrow -24 \neq 0 \Rightarrow x_1, x_4 - \text{cb. nfp.}$$

$$\left\{ \begin{array}{l} 3x_1 + 2x_2 - 2x_3 + x_4 = -7 \\ 6x_3 + 2x_5 = 10 \\ x_5 = -34 \end{array} \right.$$

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№ 2.1.46 (прогрессивное)

$$\begin{cases} 2x_2 - 2x_3 = 7 - 3x_4 - x_5 \\ x_3 = 13 \end{cases}$$

$$\begin{cases} x_5 = -34 \\ x_2 = \frac{19}{2} - \frac{3}{2}x_1 - \frac{1}{2}x_4 \end{cases}$$

$$\begin{cases} x_3 = 13 \\ x_5 = -34 \end{cases}$$

$$\boxed{\begin{cases} x_1 = t_1, x_4 = t_2, \text{ тогда общ. } p\text{-ue:} \\ (t_1; \frac{19}{2} - \frac{3}{2}t_1 - \frac{1}{2}t_2; 13; t_2; -34) \end{cases}}$$

$$\boxed{\begin{cases} t_1 = 3, t_2 = 10, \text{ тогда част. } p\text{-ue:} \\ (3; 0; 13; 10; -34) \end{cases}}$$

№ 2.1.47

$$\begin{cases} x_1 + x_2 + 3x_3 - 2x_4 + 3x_5 = 1 \\ 2x_1 + 2x_2 + 4x_3 - x_4 + 3x_5 = 2 \\ 3x_1 + 3x_2 + 5x_3 - 2x_4 + 3x_5 = 1 \\ 2x_1 + 2x_2 + 8x_3 - 3x_4 + 9x_5 = 2 \end{cases}$$

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$$\sim \left(\begin{array}{ccccc|c} 1 & 1 & 3 & -2 & 3 & 1 \\ 2 & 2 & 4 & -1 & 3 & 2 \\ 3 & 3 & 5 & -2 & 3 & 1 \\ 2 & 2 & 8 & -3 & 9 & 2 \end{array} \right) \xrightarrow{\text{II} - 2\text{I}} \sim$$

$$\sim \left(\begin{array}{ccccc|c} 1 & 1 & 3 & -2 & 3 & 1 \\ 0 & 0 & -2 & 3 & -3 & 0 \\ 3 & 3 & 5 & -2 & 3 & 1 \\ 2 & 2 & 8 & -3 & 9 & 2 \end{array} \right) \xrightarrow{\text{III} - 3\text{I}} \sim$$

$$\sim \left(\begin{array}{ccccc|c} 1 & 1 & 3 & -2 & 3 & 1 \\ 0 & 0 & -2 & 3 & -3 & 0 \\ 0 & 0 & -4 & 4 & -6 & -2 \\ 2 & 2 & 8 & -3 & 9 & 2 \end{array} \right) \xrightarrow{\text{IV} - 2\text{I}} \sim$$

$$\sim \left(\begin{array}{ccccc|c} 1 & 1 & 3 & -2 & 3 & 1 \\ 0 & 0 & -2 & 3 & -3 & 0 \\ 0 & 0 & 0 & -2 & 0 & -2 \\ 0 & 0 & 2 & 1 & 3 & 0 \end{array} \right) \xrightarrow{\text{IV} + \text{II}} \sim$$

$$\sim \left(\begin{array}{ccccc|c} 1 & 1 & 3 & -2 & 3 & 1 \\ 0 & 0 & -2 & 3 & -3 & 0 \\ 0 & 0 & 0 & -2 & 0 & -2 \\ 0 & 0 & 0 & 4 & 0 & 0 \end{array} \right) \xrightarrow{\text{IV} + 2\text{III}} \sim$$

$$\sim \left(\begin{array}{ccccc|c} 1 & 1 & 3 & -2 & 3 & 1 \\ 0 & 0 & -2 & 3 & -3 & 0 \\ 0 & 0 & 0 & -2 & 0 & -2 \\ 0 & 0 & 0 & 0 & 0 & -4 \end{array} \right) \Rightarrow$$

$\Rightarrow r(A) \neq r(A|B) \Rightarrow$ сист. несolv.

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