БӨЖ 7. Предикат, логикалық функция

1. Келесі логикалық функцияларды жазып көрсетіңіз:

1. $l_{57}^2, D=\{1,2,3,4,5\}$
2. $l_{157}^2, D=\{1,2,3,4,5\}$
3. $l_{257}^2, D=\{1,2,3,4,5\}$
4. $l_{357}^2, D=\{1,2,3,4,5\}$
5. $l_{457}^2, D=\{1,2,3,4,5\}$
6. $l_{557}^2, D=\{1,2,3,4,5\}$
7. $l_{657}^2, D=\{1,2,3,4,5\}$
8. $l_{757}^2, D=\{1,2,3,4,5\}$
9. $l_{857}^2, D=\{1,2,3,4,5\}$
10. $l_{957}^2, D=\{1,2,3,4,5\}$
11. $l_{67}^3, D=\{1,2,3\}$
12. $l_{167}^3, D=\{1,2,3\}$
13. $l_{267}^3, D=\{1,2,3\}$
14. $l_{367}^3, D=\{1,2,3\}$
15. $l_{467}^3, D=\{1,2,3\}$
16. $l_{567}^3, D=\{1,2,3\}$
17. $l_{667}^3, D=\{1,2,3\}$
18. $l_{767}^3, D=\{1,2,3\}$
19. $l_{867}^3, D=\{1,2,3\}$
20. $l_{967}^3, D=\{1,2,3\}$

2. $Q(x,y)\to(\forall xP(x,y)\to\exists xP(x,x))$ формуласының айнымалылар мен иондардың төменде берілген мәндері кезіндегі мәндерін есептеңіз (D={1,2}):

1. $x=1, y=1,\ P(x,y)=l_{14}^2,\ Q(x,y)=l_{12}^2$
2. $x=1, y=2,\ P(x,y)=l_{15}^2,\ Q(x,y)=l_{13}^2$
3. $x=2, y=1,\ P(x,y)=l_{13}^2,\ Q(x,y)=l_{11}^2$
4. $x=2, y=2,\ P(x,y)=l_{11}^2,\ Q(x,y)=l_{9}^2$
5. $x=1, y=1,\ P(x,y)=l_{9}^2,\ Q(x,y)=l_{7}^2$
6. $x=1, y=2,\ P(x,y)=l_{7}^2,\ Q(x,y)=l_{5}^2$
7. $x=2, y=1,\ P(x,y)=l_{5}^2,\ Q(x,y)=l_{3}^2$
8. $x=2, y=2,\ P(x,y)=l_{3}^2,\ Q(x,y)=l_{1}^3$
9. $x=1, y=1,\ P(x,y)=l_{2}^2,\ Q(x,y)=l_{4}^2$
10. $x=1, y=2,\ P(x,y)=l_{4}^2,\ Q(x,y)=l_{6}^2$

11. $x=2, y=1, \quad P(x,y)=l_6^2, \quad Q(x,y)=l_8^2$
12. $x=2, y=2, \quad P(x,y)=l_8^2, \quad Q(x,y)=l_{10}^2$
13. $x=1, y=1, \quad P(x,y)=l_{10}^2, \quad Q(x,y)=l_{12}^2$
14. $x=1, y=2, \quad P(x,y)=l_{12}^2, \quad Q(x,y)=l_{14}^2$
15. $x=2, y=1, \quad P(x,y)=l_{14}^2, \quad Q(x,y)=l_{15}^2$
16. $x=2, y=2, \quad P(x,y)=l_1^2, \quad Q(x,y)=l_6^2$
17. $x=1, y=1, \quad P(x,y)=l_3^2, \quad Q(x,y)=l_8^2$
18. $x=1, y=2, \quad P(x,y)=l_5^2, \quad Q(x,y)=l_{10}^2$
19. $x=2, y=1, \quad P(x,y)=l_7^2, \quad Q(x,y)=l_{12}^2$
20. $x=2, y=2, \quad P(x,y)=l_9^2, \quad Q(x,y)=l_{14}^2$

3. Келесі формулалар үшін ақиқаттық кестесін құрыңыз:

1. $P(x) \wedge \exists x Q(x), D=\{0,1\}$
2. $\exists y P(x,y) \to \forall x P(x,x), D=\{a,b\}$
3. $P(x,y) \to \forall z(P(x) \wedge Q \sim \exists y Q(x,y,z)), D=\{0\}$
4. $\forall x(P \vee Q(X)) \sim P \vee \forall x Q(x), D=\{1,2\}$
5. $\forall x P(x) \to P(x,y), D=\{0,1\}$
6. $\forall x P(x) \vee Q(x) \to \exists x Q(x) \wedge P(x), D=\{0,1\}$
7. $P(x) \to \forall x Q(x) \vee \neg Q(x), D=\{0,1\}$
8. $P(y) \to \neg(\forall x Q(x,y) \to P(y)), D=\{1\}$
9. $\neg \forall x P(x) \to (\exists y Q(y) \to P(x,y)) \vee P(y), D=\{1\}$
10. $\forall x \neg P(y) \to Q(x,y,z) \vee \forall y P(y), D=\{1\}$
11. $\forall y P(z,y) \to \forall z P(z,y), \ D=\{1,2\}$
12. $\neg \exists y Q(y,y) \wedge P(y), \ D=\{1,2\}$
13. $\forall x(P(x) \vee P(x,y)), \ D=\{0\}$
14. $\exists x P(x) \to \forall x Q(x) \vee \neg Q(x), \ D=\{0,1\}$
15. $\forall x P(x) \vee \forall y Q(y,x), \ D=\{1,2\}$
16. $P(x) \to \forall x(Q(x) \wedge \neg P(y)), \ D=\{1,2\}$
17. $\forall x \exists y P(x,y) \to \exists y \forall x P(x,y), \ D=\{1,2\}$
18. $\forall x P(x,y) \to \exists x Q(x), \ D=\{1,2\}$
19. $P(y) \vee \forall x(P(x) \to Q), \ D=\{a,b\}$
20. $\forall x(P(x,y) \to \exists x P(x,x)), \ D=\{a,b\}$

БӨЖ 8. Логика алгебрасының функциялары. Формулалар

1. Вектор түрінде берілген $f(x_1,x_2)$ және $g(x_1,x_2)$ функциялары бойынша *h* функциясын құрыңыз:

1. $f = (0001), g = (1101), h(x_1, x_2, x_3) = f(x_2, g(x_1, x_3)) \vee g(x_2, x_3)$
2. $f = (0111), g = (1101), h(x_1, x_2, x_3) = f(g(x_1, x_2), x_1) \,\&\, g(x_1, x_3)$
3. $f = (1001), g = (1101), h(x_1, x_2, x_3) = f(x_1, x_2) \oplus g(f(x_1, x_1), x_3)$
4. $f = (0110), g = (1101), h(x_1, x_2, x_3) = f(x_1, x_3) \sim g(x_2, f(x_1, x_1))$
5. $f = (1110), g = (1101), h(x_1, x_2, x_3) = f(x_1, f(x_1, x_1)) \to g(x_2, x_3)$
6. $f = (1000), g = (1101), h(x_1, x_2, x_3) = f(f(x_2, x_2), x_1) \downarrow g(x_2, x_3)$
7. $f = (1011), g = (1101), h(x_1, x_2, x_3) = f(x_1, x_3) \mid g(g(x_2, x_3), x_3)$
8. $f = (0010), g = (1101), h(x_1, x_2, x_3) = f(x_3, x_1) \vee g(x_2, g(x_3, x_3))$
9. $f = (0100), g = (1101), h(x_1, x_2, x_3) = f(x_3, g(x_2, x_1)) \,\&\, g(x_2, x_2)$
10. $f = (0001), g = (0100), h(x_1, x_2, x_3) = f(g(x_2, x_3), x_1) \oplus g(x_1, x_2)$
11. $f = (0111), g = (0100), h(x_1, x_2, x_3) = f(x_3, x_1) \to g(f(x_2, x_3), x_1)$
12. $f = (1001), g = (0100), h(x_1, x_2, x_3) = f(x_2, f(x_3, x_2)) \downarrow g(x_1, x_3)$
13. $f = (0110), g = (0100), h(x_1, x_2, x_3) = f(f(x_1, x_3), x_3) \mid g(x_3, x_2)$
14. $f = (1000), g = (0100), h(x_1, x_2, x_3) = f(x_2, x_1) \vee g(g(x_1, x_1), x_3)$
15. $f = (0010), g = (0100), h(x_1, x_2, x_3) = f(x_3, x_3) \,\&\, g(x_3, g(x_1, x_2))$
16. $f = (1110), g = (0100), h(x_1, x_2, x_3) = f(x_1, g(x_3, x_2)) \oplus g(x_3, x_1)$
17. $f = (0111), g = (1110), h(x_1, x_2, x_3) = f(g(x_3, x_1), x_2) \sim g(x_2, x_1)$
18. $f = (1001), g = (1110), h(x_1, x_2, x_3) = f(x_3, f(x_2, x_3)) \to g(x_3, x_1)$
19. $f = (0110), g = (1110), h(x_1, x_2, x_3) = f(x_2, x_3) \downarrow g(f(x_3, x_2), x_1)$
20. $f = (1000), g = (1110), h(x_1, x_2, x_3) = f(x_3, x_1) \mid g(g(x_3, x_3), x_2)$

2. Төменде берілген $f(x_1, x_2, x_3)$ функциясы үшін

а) оның барлық айрықша және жалған айнымалыларын анықтаңыз;

ә) оның тек айрықша айнымалылар кіретін кестесін көрсетіңіз:

1. $f = (01100110)$
2. $f = (01100110)$
3. $f = (00110000)$
4. $f = (00001010)$
5. $f = (00111010)$

6. $f = (00111100)$
7. $f = (00001001)$
8. $f = (11001001)$
9. $f = (10001001)$
10. $f = (10100110)$
11. $f = (01000010)$
12. $f = (01001010)$
13. $f = (01111110)$
14. $f = (01101110)$
15. $f = (01110110)$
16. $f = (01011100)$
17. $f = (00001111)$
18. $f = (10010101)$
19. $f = (11001011)$
20. $f = (11000111)$

3. Төменде берілген $f(x, y, z)$ функциясының кестесін құрыңыз:

1. $f = ((((x + y) \to \bar{y}) \wedge (\bar{y} \to (x \mid \bar{z})) \wedge (x + y)) \to (x \mid \bar{z})) \wedge (x \vee z)$;
2. $f = (((x + y) \wedge \overline{y \sim z}) \vee ((y + z) \to (x \sim y))) \wedge ((x \mid x) \vee y)$;
3. $f = ((\bar{x} \vee z) \to (((y + x) \wedge \bar{z}) \vee ((x \vee (x + y)) \to z))) \wedge (\bar{x} \downarrow y)$;
4. $f = ((x + y + 1) \to ((\bar{x} \mid (\bar{y} \wedge z)) \vee (x \sim y))) \wedge (\bar{x} \sim z)$;
5. $f = ((x \wedge \bar{y}) \to (\overline{\bar{x} \vee y} \vee ((y \sim z) \downarrow (x + \bar{z})))) \wedge (\bar{z} + x)$;
6. $f = ((\bar{x} \vee (y \sim \bar{z})) \to (\overline{x \to z} \vee (\bar{x} \vee ((\bar{y} \sim z) \wedge z)))) \wedge (y + z)$;
7. $f = (((x + \bar{y} + z) \wedge (y \vee (z \mid \bar{x}))) \to (y \vee (z \mid \bar{x}))) \wedge (z \downarrow \overline{z \to x})$;
8. $f = ((\overline{x \vee y} \wedge ((y + z) \to (\bar{x} \sim (y \mid z)))) \to (x \downarrow y)) \wedge (\bar{x} \vee y)$;
9. $f = ((\bar{x} \vee y) \to ((x \mid x \vee \overline{y \wedge \bar{z}}) \to (x \to z))) \wedge (z + y)$;
10. $f = ((x \mid x) \downarrow \bar{y}) \to (((\bar{x} + z) \sim y) \to (x \wedge y))) \wedge (x \mid \bar{z})$;
11. $f = (((((x \wedge (y \vee z)) \to (z \mid x)) \wedge (x \to (y \vee z))) \wedge x) \to (x \mid z)) \wedge (x \vee z)$;
12. $f = ((((x + \bar{y}) \to y) \wedge (y \to (x \mid \bar{z})) \wedge (x + \bar{y})) \to (x \mid \bar{z})) \wedge (x \vee z)$;
13. $f = (((\bar{x} + y) \wedge \overline{y \sim z}) \vee ((y + z) \to (\bar{x} \sim y))) \wedge ((\bar{x} \mid \bar{x}) \vee y)$;
14. $f = ((\bar{x} \vee \bar{z}) \to (((y + x) \wedge z) \vee ((x \vee (x + y)) \to \bar{z}))) \wedge (\bar{x} \downarrow y)$;
15. $f = ((\bar{x} + y + 1) \to ((x \mid (\bar{y} \wedge z)) \vee (\bar{x} \sim y))) \wedge (x \sim z)$;
16. $f = ((x \wedge y) \to (\overline{\bar{x} \vee \bar{y}} \vee ((\bar{y} \sim z) \downarrow (x + z)))) \wedge (\bar{z} \vee x)$;

17. $f = ((\bar{x} \vee (y \sim z)) \to (\overline{x \to z} \vee (\bar{x} \vee ((\bar{y} \sim \bar{z}) \wedge \bar{z})))) \wedge (y + \bar{z})$;
18. $f = (((\bar{x} + \bar{y} + z) \wedge (y \vee (z \mid x))) \to (y \vee (z \mid x))) \wedge (z \downarrow z \to \bar{x})$;
19. $f = ((\overline{\bar{x} \vee y} \wedge ((y + z) \to (x \sim (y \mid z)))) \to (\bar{x} \downarrow y)) \wedge (x \vee y)$;
20. $f = ((\bar{x} \vee y) \to ((x \mid x \vee \overline{y \wedge z}) \to (x \to \bar{z}))) \wedge (\bar{z} + y)$.

БӨЖ 9. Элементар функциялардың қасиеттері. Екіжақтылық қағидасы

1. Негізгі эквиваленттіктерді қолдана отырып Ф және Ψ формулаларының эквивалентті екенін дәлелдеңіз:

1. $\Phi = \overline{(x_3 \mid x_2)} \mid ((x_3 \downarrow x_1) \vee \overline{x}_3)$, $\Psi = (x_1 \downarrow (x_2 \to x_1)) \to (x_2 \vee x_3)$
2. $\Phi = x_3 \mid ((x_1 \oplus x_2) \sim x_2)$, $\Psi = \overline{(x_2 \downarrow x_3)} \mid ((x_1 \sim x_3) \downarrow x_1)$
3. $\Phi = x_2 x_3 \overline{((x_3 \mid (x_3 \downarrow x_2))} \vee (x_2 \sim (x_3 \oplus x_1)))$, $\Psi = (x_2 \mid x_3) \downarrow (x_1 x_3)$
4. $\Phi = (x_2 \mid x_1) \sim (x_3 \oplus x_1) \sim (x_1 \vee x_3)$, $\Psi = \overline{x}_1 \vee (x_2 \sim x_3)$
5. $\Phi = (x_3 \sim (x_2 x_3)) \oplus ((x_2 \vee x_1) x_1)$, $\Psi = x_1 \oplus (x_3 \to x_2)$
6. $\Phi = ((x_1 \oplus x_2) \mid (x_2 \vee x_1)) \sim (x_3 \mid x_2)$, $\Psi = x_1 \oplus (x_2 \to x_3)$
7. $\Phi = ((x_3 \sim x_1) \mid x_1) \downarrow (x_3 \mid x_2)$, $\Psi = x_1(x_2 x_3 \vee (x_1 \downarrow x_2))$
8. $\Phi = (x_3 \vee (x_2 \sim x_1)) \to (\overline{x}_3 \to x_1)$, $\Psi = \overline{\overline{((x_2 \sim x_3)} \downarrow (x_2 \vee x_1))}$
9. $\Phi = (x_1 x_3) \to ((x_1 \oplus x_2) \vee x_2 \vee x_1)$, $\Psi = (\overline{x}_1 \downarrow (x_1 \vee x_3)) \mid (x_1 \vee x_2 x_3)$
10. $\Phi = (x_1(x_3 \sim x_1)) \downarrow (\overline{x}_1 \vee (x_2 \mid x_1))$, $\Psi = \overline{((x_1 x_1 x_2) \to (x_3 x_1))}$
11. $\Phi = (x_2(x_3 \to x_2)) \downarrow ((x_1 \to x_2) \vee x_3)$, $\Psi = \overline{x}_3 \overline{(x_1 \mid (x_3 \sim x_2))}$
12. $\Phi = (x_2 \to x_1) \mid (x_3 \vee x_1 \vee (x_1 \mid x_2))$, $\Psi = x_1 \oplus (x_1 \vee (x_1 \oplus x_2))$
13. $\Phi = ((x_2 \oplus x_3) \mid (x_1 \sim x_2)) x_3 x_1$, $\Psi = ((x_2 \downarrow x_1) \vee (x_1 \sim x_3)) x_1$
14. $\Phi = ((x_1 \to x_2) \mid x_1)(x_3 \vee (x_3 \mid x_2))$, $\Psi = x_1 \to ((x_2 \vee x_3) \to \overline{x}_2)$
15. $\Phi = ((x_2 \oplus x_3)(x_3 \mid x_1)) \mid (\overline{x}_3 \oplus (x_3 \mid x_2))$, $\Psi = (x_1 \oplus x_3) \mid (x_1 \downarrow x_2)$
16. $\Phi = ((x_3 \vee x_1) \sim (x_3 \oplus x_2)) \vee (x_3 \mid \overline{x}_2)$, $\Psi = x_3 \vee \overline{(x_2 \mid x_3)} \vee (x_1 \mid x_3)$
17. $\Phi = x_3 \mid (x_1 \downarrow (x_2 x_3))$, $\Psi = x_3 \to ((x_1 \vee x_3) \sim (x_1 x_3 \vee (x_2 \sim x_3)))$
18. $\Phi = ((x_1 \oplus x_3) \to x_1) \vee ((x_2 \vee x_3) \oplus x_3)$, $\Psi = \overline{(x_2 \downarrow x_3)} \mid ((x_3 \sim x_1) \downarrow x_1)$
19. $\Phi = (x_1 \sim x_3) \mid ((\overline{x}_3 \to (x_1 \mid x_2)) x_1)$, $\Psi = (x_1 \to (x_2 \downarrow x_3)) \vee (x_1 \oplus x_3)$
20. $\Phi = x_1 \oplus (x_1 \vee ((x_2 \sim x_1) \to (x_2 \oplus x_1)))$, $\Psi = \overline{(x_2 \to x_1)}(x_2(x_1 \vee x_3) \vee x_2)$

2. Түйіспелі схеманы құрыңыз:

1. $\overline{xyz} \vee \overline{x} \vee y \vee z \vee \overline{xy} \vee \overline{xyz}$
2. $\overline{xyz} \vee \overline{yz} \vee \overline{x} \vee x \vee y \vee z$
3. $\overline{xyz} \vee \overline{xy} \vee x \vee y \vee z \vee \overline{xyz}$
4. $\overline{xyz} \vee x \vee y \vee \overline{xyz} \vee x \vee y \vee z$
5. $\overline{yz} \vee \overline{xyz} \vee \overline{xyz} \vee x \vee y \vee z$
6. $\overline{xyz} \vee x \vee y \vee x \vee \overline{y} \vee z \vee \overline{xyz}$
7. $\overline{xyz} \vee \overline{xyz} \vee \overline{x} \vee y \vee \overline{xyz}$
8. $\overline{xyz} \vee \overline{yz} \vee \overline{xz} \vee x \vee y \vee z$
9. $\overline{xyz} \vee x \vee y \vee \overline{xyz} \vee \overline{x} \vee \overline{y} \vee z$
10. $\overline{xyz} \vee \overline{yz} \vee \overline{xy} \vee x \vee \overline{y}$
11. $\overline{xyz} \vee y \vee \overline{z} \vee \overline{xyz} \vee x \vee y \vee \overline{z}$
12. $\overline{xyz} \vee \overline{xyz} \vee \overline{y} \vee z \vee \overline{xyz}$
13. $\overline{xyz} \vee \overline{xz} \vee \overline{xy} \vee x \vee y \vee z$
14. $\overline{xyz} \vee \overline{z} \vee \overline{y} \vee \overline{xyz} \vee \overline{x} \vee \overline{y} \vee \overline{z}$
15. $\overline{xyz} \vee \overline{xz} \vee \overline{yz} \vee y \vee \overline{z}$
16. $\overline{xyz} \vee x \vee y \vee \overline{z} \vee \overline{xz} \vee \overline{xyz}$
17. $\overline{x} \vee \overline{y} \vee \overline{z} \vee \overline{xyz} \vee \overline{xyz} \vee \overline{xyz}$
18. $\overline{xz} \vee \overline{xyz} \vee \overline{xyz} \vee x \vee y \vee z$
19. $\overline{xyz} \vee x \vee \overline{z} \vee \overline{xyz} \vee x \vee y \vee z$
20. $\overline{xy} \vee \overline{xyz} \vee \overline{xyz} \vee x \vee y \vee z$

БӨЖ 10. Буль функцияларының айнымалылар бойынша жіктелулері. Толықтық және тұйықтық. Маңызды тұйық кластар

1. ЖДҚФ және ЖККҚФ құрыңыз:

1. $(x_2 \vee x_1) \mid (x_3 \sim \overline{x}_1)$
2. $(x_1 \mid x_2) \downarrow (x_3 \mid x_1)$
3. $(((x_2x_1) \vee \overline{x}_3) \to \overline{x}_3)$
4. $(((x_1x_2) \to x_3) \vee \overline{x}_2)$
5. $((x_2 \vee x_3)x_1) \sim (x_1 \vee x_2)$
6. $((x_3 \to x_1) \downarrow \overline{x}_2) \mid \overline{x}_1$
7. $\overline{x_2 \sim x_3} \to (x_1 \vee x_2)$
8. $((x_2 \mid x_3) \downarrow x_3) \downarrow x_1$
9. $x_2 \to \overline{\overline{x_3 \mid x_1} \sim x_1}$
10. $((x_2 \to \overline{x}_1)x_3) \mid \overline{x}_2$
11. $\overline{(x_3 \mid x_2) \vee x_1} \downarrow x_3$
12. $((x_1 \vee x_2) \sim x_3) \downarrow x_1$
13. $(x_1 \vee (x_3x_2)) \oplus x_2$
14. $(x_3 \mid x_2) \sim (x_1 \vee x_2)$
15. $(x_1 \to x_3) \downarrow (x_2 \to (x_1x_3))$
16. $(x_3 \oplus x_2) \to (x_1 \mid x_3)$
17. $(x_3 \mid x_1) \to (x_2 \to x_1)(x_2 \to x_3)$
18. $x_1 \mid ((x_2 \oplus x_3)x_1x_3)$
19. $(x_1 \vee x_3) \to ((x_2 \vee x_1) \oplus x_2)$
20. $((x_3 \mid x_2) \downarrow (x_1 \downarrow x_2)) \mid x_3$

2. Эквивалентті түрлендірулер көмегімен ДҚФ-ға және КҚФ-ға келтіріңіз:

1. $\overline{x}_2((x_3 \to x_1) \oplus x_2)$
2. $((x_1 \downarrow \overline{x}_3) \mid x_1)\overline{x}_2$
3. $((x_3 \sim x_1) \vee x_2) \oplus x_1$
4. $x_3 \mid (\overline{(x_2\overline{x}_1)} \mid (x_1\overline{x}_2x_3))$
5. $((((x_1 \oplus \overline{x}_3) \vee \overline{x}_2)\overline{x}_2) \oplus \overline{x}_1)$
6. $((x_1 \downarrow x_3) \vee (x_2 \mid x_2)\overline{x}_1)$
7. $(x_1 \vee \overline{x}_2)\overline{(x_2 \vee \overline{x}_3)}(x_2 \vee \overline{x}_1)\overline{x}_1$

8. $x_2 \vee (x_1 \oplus x_3)(x_1 \vee \overline{x}_2)$
9. $((x_1 \sim x_3)x_2) \oplus x_1$
10. $((x_1 \sim x_3) \to x_2) \vee x_2$
11. $(((x_1 \oplus x_2) \sim \overline{x}_1) \downarrow \overline{x}_3)$
12. $x_3 \mid (\overline{(x_1\overline{x}_2)} \oplus \overline{x}_1)$
13. $(((x_3 \vee x_2)x_1) \sim x_1)$
14. $(x_3 \mid (\overline{(x_1 \to \overline{x}_2)})) \mid \overline{x}_3$
15. $((x_1 \downarrow \overline{x}_2) \mid (x_3\overline{x}_1))x_3$
16. $(x_2 \to x_1)x_2(x_3 \vee \overline{x}_2)$
17. $(x_1 \mid x_3)x_2 \sim x_1$
18. $((x_3x_1) \sim x_2)(x_1 \sim x_2)$
19. $(x_1 \vee \overline{(x_2 \sim \overline{x}_3)} \vee \overline{x}_3) \sim x_2$
20. $x_1((x_3 \to \overline{x}_2) \oplus x_2)$

3. Жегалкин полиномын құрыңыз:
а) анықталмаған коэффициенттер әдісімен;
ә) Паскаль үшбұрышының көмегімен:

1. $f = (01010001)$
2. $f = (10011000)$
3. $f = (01001100)$
4. $f = (00100110)$
5. $f = (00010011)$
6. $f = (10001001)$
7. $f = (11000100)$
8. $f = (01100010)$
9. $f = (00110001)$
10. $f = (00011010)$
11. $f = (00001101)$
12. $f = (10000110)$
13. $f = (01000011)$
14. $f = (10111100)$
15. $f = (01011110)$

16. $f = (00101111)$
17. $f = (10010111)$
18. $f = (11001011)$
19. $f = (11100011)$
20. $f = (11110001)$

4. *A* функциялар жүйесі функционалды толық па екенін анықтаңыз:

1. $A = \{0,\ xy,\ x\overline{(y \mid z)}\}$
2. $A = \{\overline{x},\ x \oplus y,\ x \sim y \sim z\}$
3. $A = \{1,\ x \oplus y,\ x \vee y \vee z\}$
4. $A = \{0,\ xy,\ x \oplus y \oplus z\}$
5. $A = \{\overline{x},\ x \oplus y,\ (x \to y) \to z\}$
6. $A = \{1,\ x \sim y,\ xyz\}$
7. $A = \{0,\ x \vee y,\ x \sim y \sim z\}$
8. $A = \{\overline{x},\ x \sim y,\ x \to (y \to z)\}$
9. $A = \{1,\ xy,\ x \vee y \vee z\}$
10. $A = \{0,\ xy,\ (x \to y) \to z\}$
11. $A = \{x,\ x \to y,\ x \vee y \vee z\}$
12. $A = \{1,\ x \oplus y,\ xy \to z\}$
13. $A = \{0,\ x \sim y,\ (x \to y) \oplus z\}$
14. $A = \{x,\ x \to y,\ (x \oplus y) \vee z\}$
15. $A = \{1,\ x \vee y,\ x(y \sim z)\}$
16. $A = \{0,\ xy,\ x \to \overline{yz}\}$
17. $A = \{x, x \to (y \to x),\ \overline{x \to y}\}$
18. $A = \{1,\ x \vee \overline{y},\ x\overline{y} \oplus \overline{z}\}$
19. $A = \{0,\ x \oplus y \oplus 1,\ \overline{x \downarrow y} \oplus z)\}$
20. $A = \{\overline{x},\ (x \oplus y) \vee y,\ (x \vee \overline{y})z\}$

БӨЖ 11. Буль функцияларын минимизациялау

1. Берілген f функциясы үшін Квайн – Мак-класки әдісімен МДҚФ табыңыз:

1. $f = x_1x_2 \vee \overline{x_1}x_3 \vee x_1x_4 \vee \overline{x_2}\,\overline{x_3}\,\overline{x_4}$

2. $f = x_1 x_4 \vee \bar{x}_2 \bar{x}_3 \vee x_1 \bar{x}_4 \vee \overline{x_1 x_2 x_3}$
3. $f = x_2 \bar{x}_1 \vee x_1 x_3 \vee \bar{x}_2 x_4 \vee x_1 \bar{x}_3 \bar{x}_4$
4. $f = \bar{x}_1 x_3 \vee x_1 x_4 \vee \bar{x}_2 \bar{x}_3 \vee x_1 x_2 \bar{x}_4$
5. $f = x_1 x_3 \vee \overline{x_2 x_4} \vee \bar{x}_3 \bar{x}_4 \vee x_1 x_2 \bar{x}_4$
6. $f = \overline{x_2 x_4} \vee x_1 x_2 \vee \bar{x}_3 \bar{x}_4 \vee \bar{x}_1 x_3 x_4$
7. $f = \bar{x}_2 \bar{x}_3 \vee x_1 \bar{x}_4 \vee \bar{x}_1 x_2 \vee x_1 x_3 x_4$
8. $f = x_1 x_2 \vee \bar{x}_3 \bar{x}_4 \vee \bar{x}_1 x_3 \vee x_1 \bar{x}_2 x_4$
9. $f = x_1 \bar{x}_4 \vee \bar{x}_1 x_2 \vee x_1 x_3 \vee \bar{x}_2 \bar{x}_3 x_4$
10. $f = x_1 \vee \bar{x}_1 x_2 \vee x_1 x_3 x_4 \vee \bar{x}_2 \bar{x}_3 \bar{x}_4$
11. $f = x_2 \vee \bar{x}_1 x_3 \vee x_1 \bar{x}_2 x_4 \vee x_1 \bar{x}_3 \bar{x}_4$
12. $f = x_3 \vee x_1 x_4 \vee \bar{x}_2 \bar{x}_3 \bar{x}_4 \vee x_1 x_2 \bar{x}_4$
13. $f = x_1 x_3 \vee \bar{x}_2 \bar{x}_4 \vee \bar{x}_1 x_2 \vee x_1 \bar{x}_3 x_4$
14. $f = x_1 x_2 \vee \bar{x}_3 \bar{x}_4 \vee \bar{x}_1 x_4 \vee x_1 \bar{x}_2 x_3$
15. $f = x_1 x_4 \vee \bar{x}_2 \bar{x}_3 \vee \bar{x}_1 x_3 \vee x_1 x_2 \bar{x}_4$
16. $f = x_2 x_4 \vee \bar{x}_1 \bar{x}_3 \vee x_3 \bar{x}_4 \vee x_1 \bar{x}_2 x_4$
17. $f = x_2 x_3 \vee \bar{x}_1 \bar{x}_4 \vee x_1 \bar{x}_3 \vee x_3 \bar{x}_2 x_4$
18. $f = x_1 x_2 \vee \bar{x}_3 \bar{x}_4 \vee \bar{x}_2 x_3 \vee \bar{x}_1 x_2 x_4$
19. $f = x_2 x_3 \vee \bar{x}_1 \bar{x}_4 \vee \bar{x}_2 x_1 \vee x_2 \bar{x}_3 x_4$
20. $f = x_1 x_3 \vee \bar{x}_2 \bar{x}_4 \vee \bar{x}_3 x_2 \vee x_3 \bar{x}_1 x_4$

2. Берілген g функциясы үшін Карно картасының көмегімен МДҚФ табыңыз:

1. g = (1,1,1,1,1,1,0,0,0,0,0,0,0,0,1,1)
2. g = (1,1,1,1,1,1,0,0,0,0,0,0,0,1,0,1)
3. g = (1,1,1,1,1,1,0,0,0,0,0,0,0,1,1,0)
4. g = (1,1,1,1,1,1,0,0,0,0,0,0,1,0,0,1)
5. g = (1,1,1,1,1,1,0,0,0,0,0,0,1,0,1,0)
6. g = (1,1,1,1,1,1,0,0,0,0,0,0,1,1,0,0)
7. g = (1,1,1,1,1,1,0,0,0,0,0,1,0,0,0,1)
8. g = (1,1,1,1,1,1,0,0,0,0,0,1,0,0,1,0)
9. g = (1,1,1,1,1,1,0,0,0,0,0,1,0,1,0,0)
10. g = (1,1,1,1,1,1,0,0,0,0,0,1,1,0,0,0)
11. g = (1,1,1,1,1,1,0,0,0,0,1,0,0,0,0,1)
12. g = (1,1,1,1,1,1,0,0,0,0,1,0,0,0,1,0)
13. g = (1,1,1,1,1,1,0,0,0,0,1,0,0,1,0,0)
14. g = (1,1,1,1,1,1,0,0,0,0,1,0,1,0,0,0)

15. g = (1,1,1,1,1,1,0,0,0,0,1,1,0,0,0,0)
16. g = (1,1,1,1,1,1,0,0,0,1,0,0,0,0,0,1)
17. g = (1,1,1,1,1,1,0,0,0,1,0,0,0,0,1,0)
18. g = (1,1,1,1,1,1,0,0,0,1,0,0,0,1,0,0)
19. g = (1,1,1,1,1,1,0,0,0,1,0,0,1,0,0,0)
20. g = (1,1,1,1,1,1,0,0,0,1,0,1,0,0,0,0)

БӨЖ 12. Граф және оған ұқсас нысандар. Графтың метрикалық сипаттамалары

1. Берілген граф үшін анықтаңыз:

а) Графты диаграмма түрде беріңіз;

ә) Графтың төбелерінің дәрежелерін анықтаңыз;

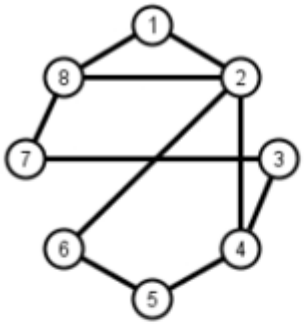
б) Графтың қаңқалы ішкі графтарын (әрбір k үшін бір мысалдан) және дұрыс ішкі графын құрыңыз;

в) Графтың төбелік-туындаған ішкі графтарын (әрбір k үшін бір мысалдан) және қырлық-туындаған ішкі графтарын құрыңыз (әрбір k үшін бір мысалдан):

1	V = {1; 2; 3; 4; 5; 6} E = {(1; 2); (1; 5); (2; 6); (3; 6); (3; 4); (4; 5); (5; 6)}	2	V = {1; 2; 3; 4; 5; 6} E = {(1; 2); (1; 6); (2; 6); (3; 5); (4; 3); (4; 5)}
3	V = {1; 2; 3; 4; 5; 6} E = {(1; 2); (2; 4); (2; 5); (3; 5); (4; 3); (4; 5); (4; 6); (5; 1)}	4	V = {1; 2; 3; 4; 5; 6} E = {(1; 2); (1; 4); (3; 6); (4; 3); (4; 5); (4; 6); (5; 1)}
5	V = {1; 2; 3; 4; 5; 6} E = {(1; 2); (1; 4); (2; 3); (2; 5); (3; 5); (3; 4); (4; 6)}	6	V = {1; 2; 3; 4; 5; 6} E = {(1; 2); (1; 6); (2; 3); (3; 4); (4; 5); (5; 1)}
7	V = {1; 2; 3; 4; 5; 6} E = {(1; 2); (1; 3); (1; 4); (3; 6); (3; 4); (4; 6); (5; 3)}	8	V = {1; 2; 3; 4; 5; 6} E = {(1; 2); (1; 4); (2; 5); (3; 6); (3; 4); (4; 6); (5; 6)}
9	V = {1; 2; 3; 4; 5; 6} E = {(1; 4); (1; 5); (2; 1); (2; 3); (3; 4); (4; 6); (5; 3); (6; 1)}	10	V = {1; 2; 3; 4; 5; 6} E = {(1; 3); (1; 4); (2; 1); (3; 4); (4; 5); (4; 6); (6; 1)}
11	V = {1; 2; 3; 4; 5; 6} E = {(1; 2); (1; 5); (2; 3); (3; 6); (3; 4); (4; 6); (5; 6)}	12	V = {1; 2; 3; 4; 5; 6} E = {(1; 2); (1; 6); (2; 5); (3; 5); (4; 3); (4; 5); (5; 6)}

13	V = {1; 2; 3; 4; 5; 6} E = {(1; 2); (2; 4); (2; 5); (3; 5); (4; 3); (4; 6); (5; 1)}	14	V = {1; 2; 3; 4; 5; 6} E = {(1; 2); (1; 4); (3; 6); (4; 3); (4; 5); (4; 6); (6; 1)}
15	V = {1; 2; 3; 4; 5; 6} E = {(1; 2); (1; 4); (1; 3); (2; 3); (4; 3); (5; 6)}	16	V = {1; 2; 3; 4; 5; 6} E = {(1; 2); (1; 5); (2; 5); (3; 6); (4; 3); (4; 6)}
17	V = {1; 2; 3; 4; 5; 6} E = {(1; 2); (1; 3); (2; 4); (3; 5); (4; 3); (4; 5); (5; 1)}	18	V = {1; 2; 3; 4; 5; 6} E = {(1; 2); (1; 3); (1; 5); (2; 5); (3; 5); (3; 4); (4; 5); (5; 6)}
19	V = {1; 2; 3; 4; 5; 6} E = {(1; 2); (1; 3); (2; 3); (2; 5); (3; 5); (3; 4); (4; 5); (5; 6)}	20	V = {1; 2; 3; 4; 5; 6} E = {(1; 2); (1; 4); (3; 6); (4; 3); (4; 5); (4; 6); (5; 1)}

2. Берілген графтың радиусын, диаметрін және ортасын анықтаңыз:



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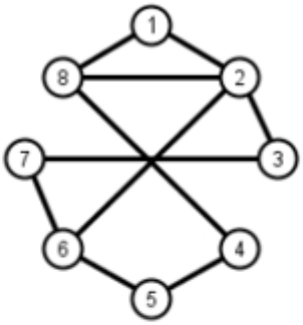

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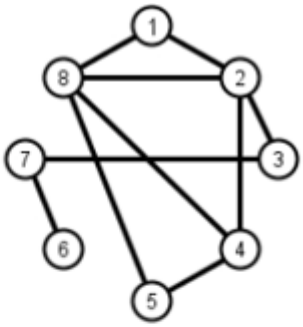

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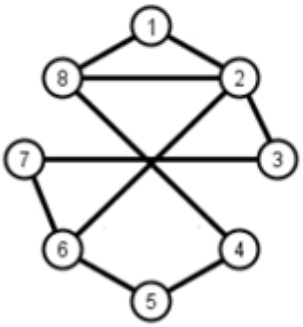

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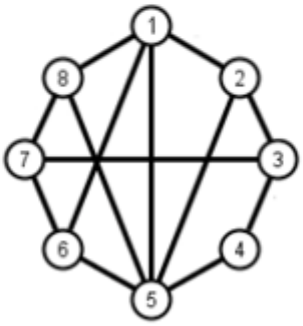

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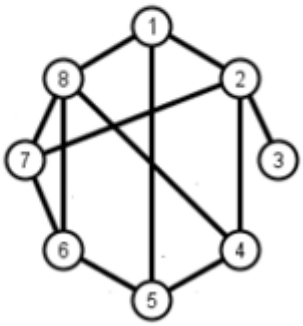

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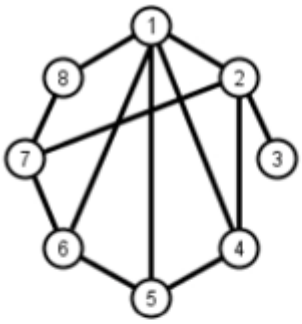

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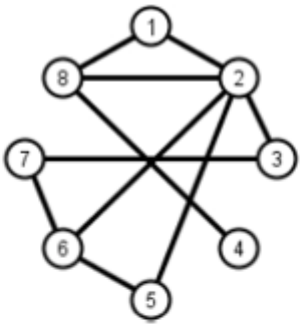

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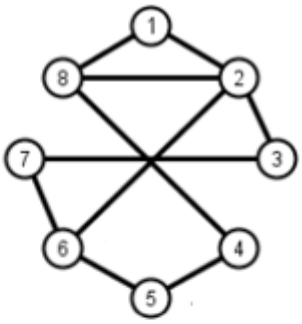

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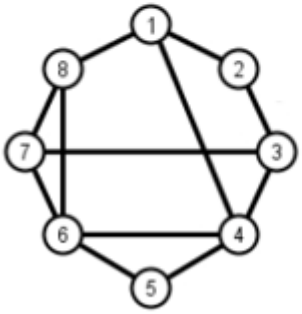

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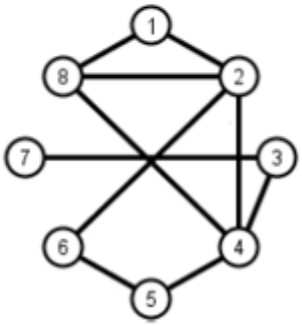

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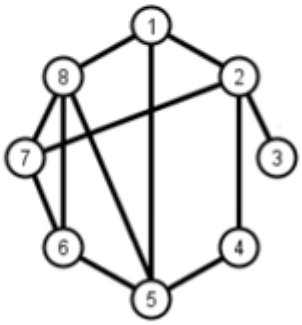

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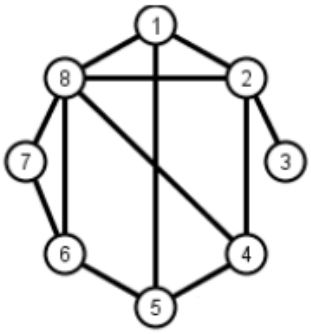

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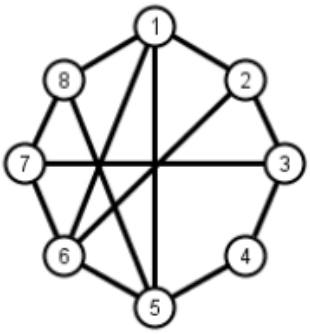

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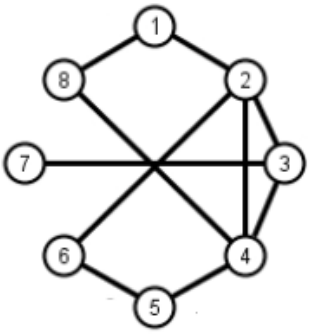

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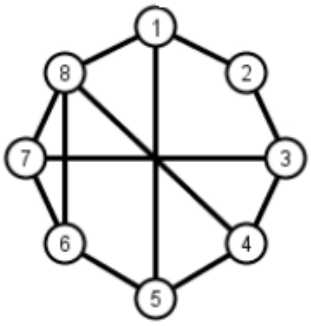

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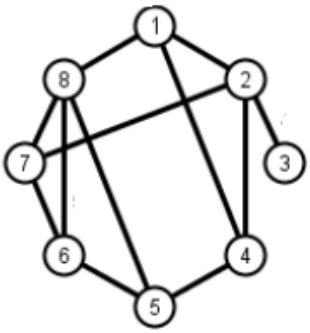

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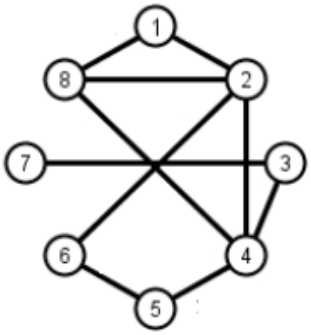

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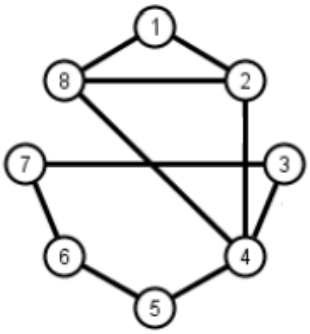

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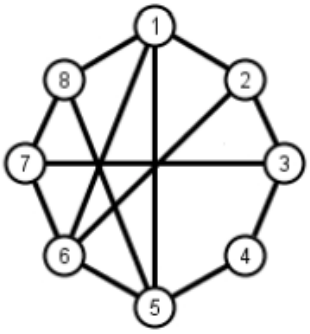

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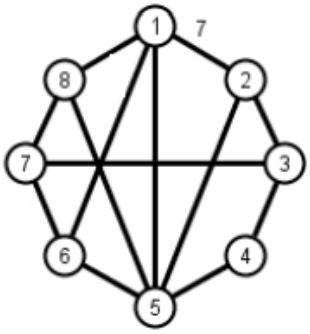


21

БӨЖ 13. Графтарға қолданылатын амалдар. Ағаштар және олардың негізгі қасиеттері. Эйлерлік графтар

1. Берілген графтарға амалдар қолданыңыз және нәтижеде алынған графтың сыбайластық матрицасын құрыңыз:

а) Графтың толықтауышын анықтаңыз (G_1);

ә) (1,2) қырын және 5-төбесін жойыңыз (G_2) ;

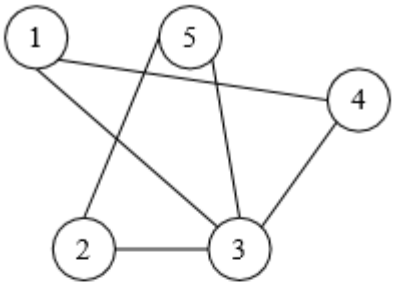
б) 6-төбені және (3,6) қырын қосыңыз (G_1);

в) Бастапқы берілген графтардың бірігуін анықтаңыз;

г) Бастапқы берілген графтардың қиылысуын анықтаңыз;

ғ) Бастапқы берілген графтардың сақиналық қосындысын анықтаңыз.

G1



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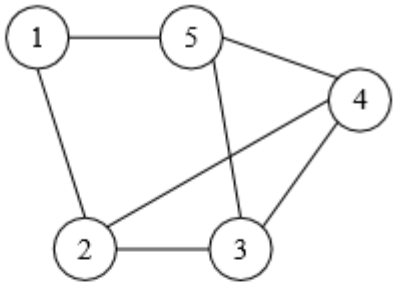

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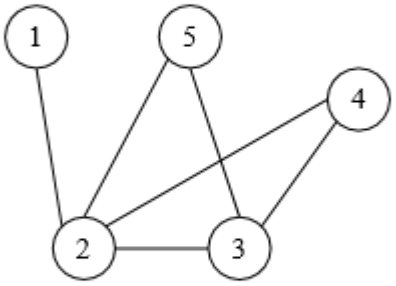

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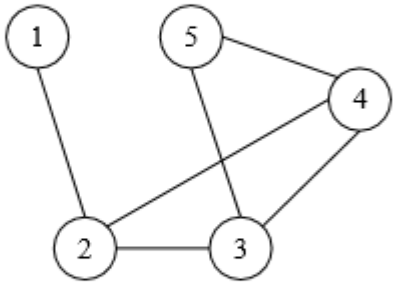

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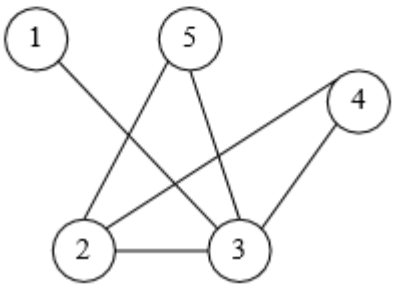

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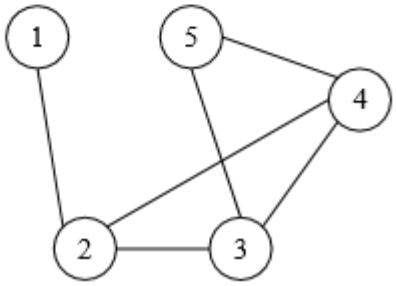

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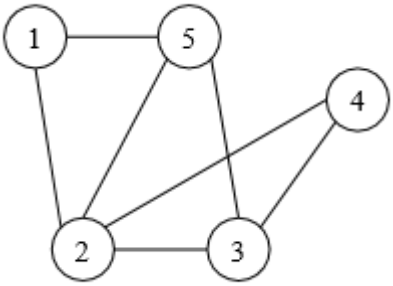

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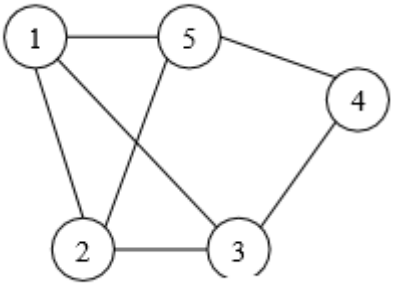

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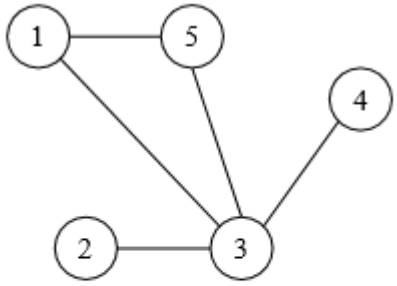

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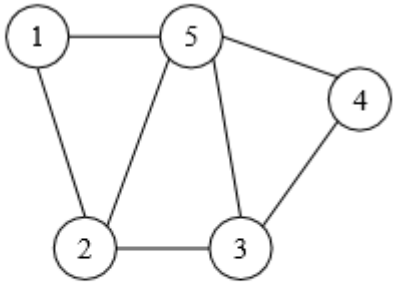

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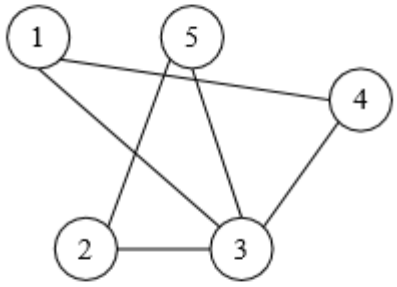

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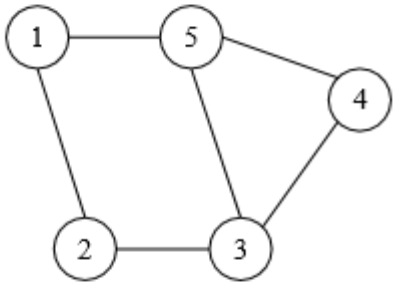

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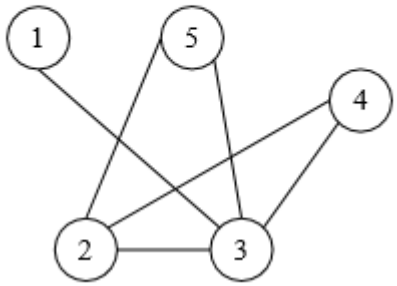

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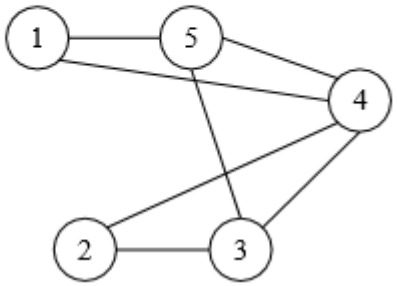

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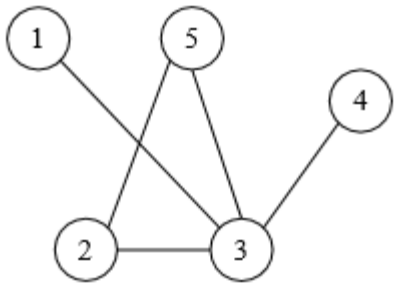

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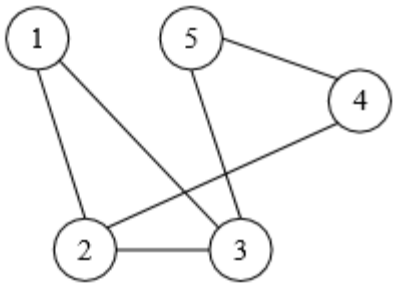

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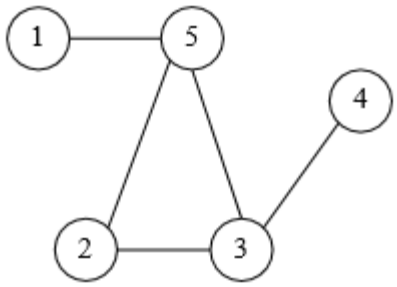

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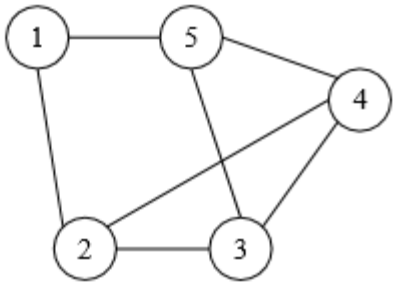

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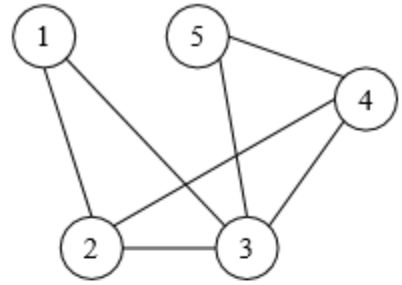

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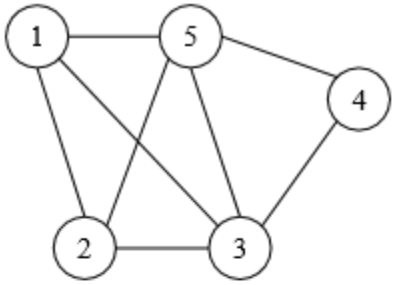

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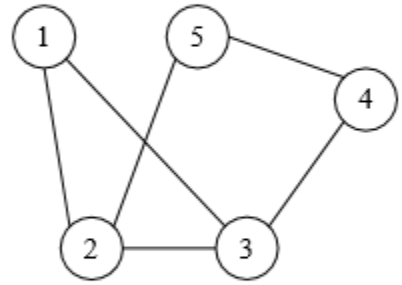

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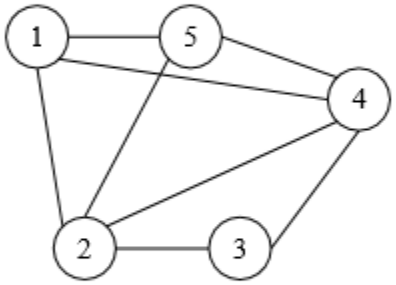

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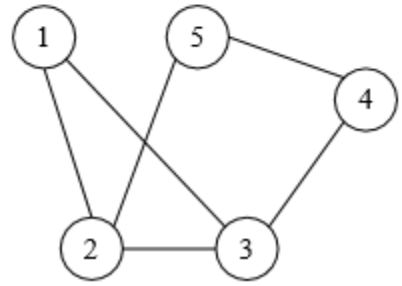

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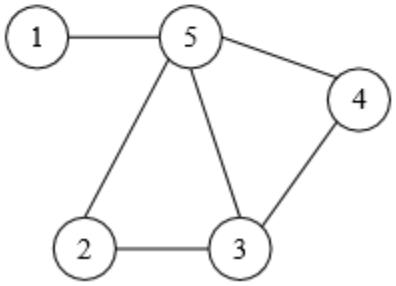

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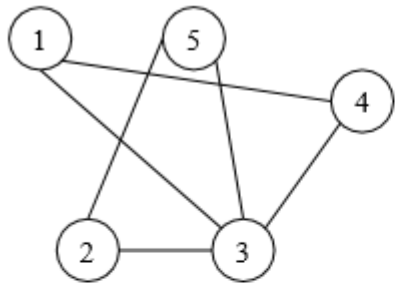

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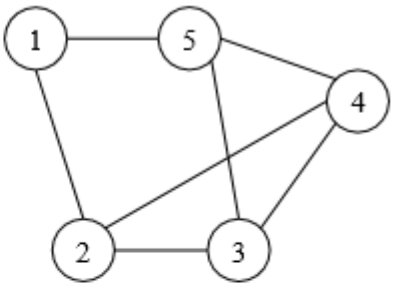

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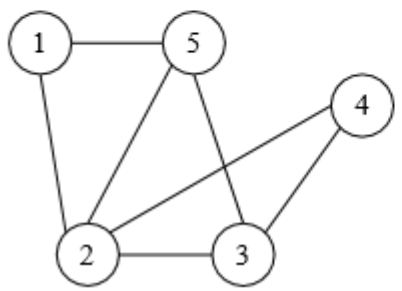

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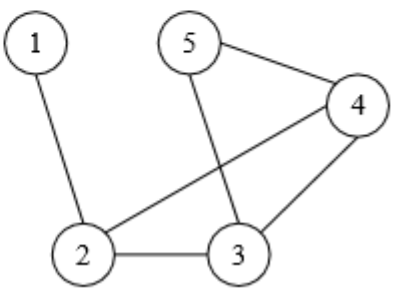

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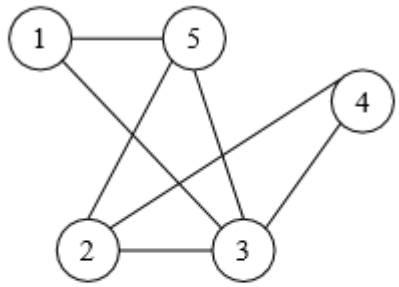

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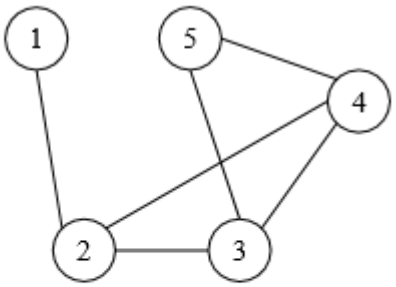

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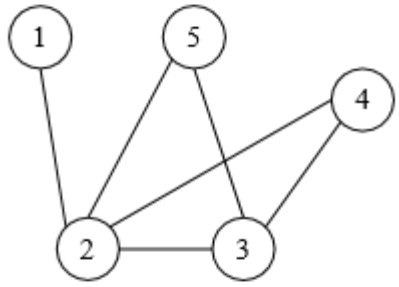

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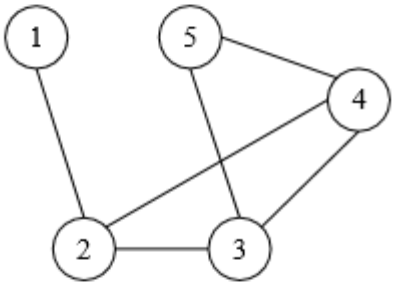

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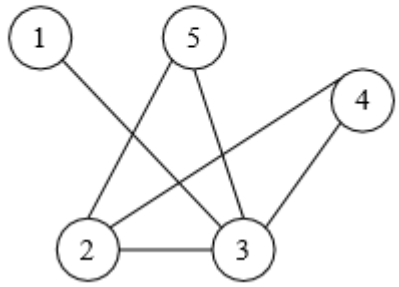

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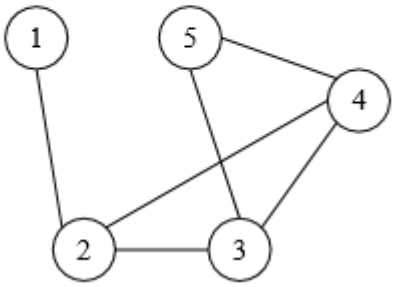

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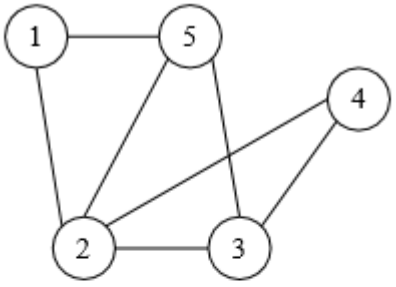

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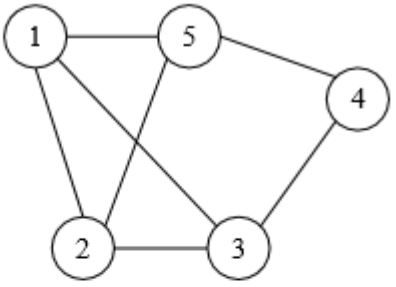

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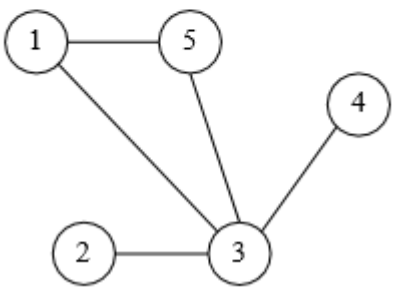

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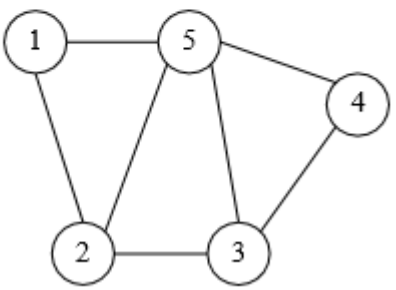

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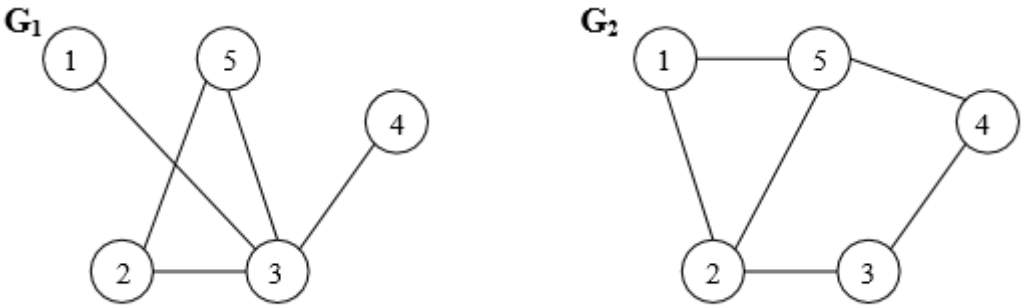
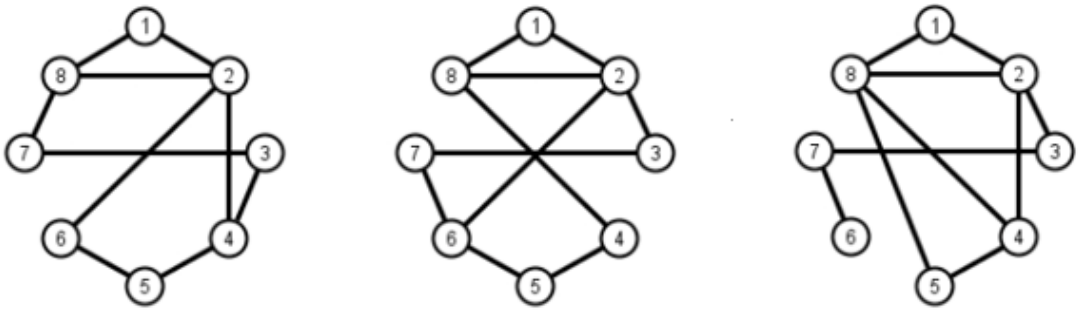


20

2. Берілген графтың қаңқасын құрыңыз (Сурет 1-21).

3. Берілген графта эйлерлік цикл (немесе эйлерлік шынжыр) бар ма екенін анықтаңыз (бар болған жағдайда оны көрсетіңіз) (Сурет 1-21).



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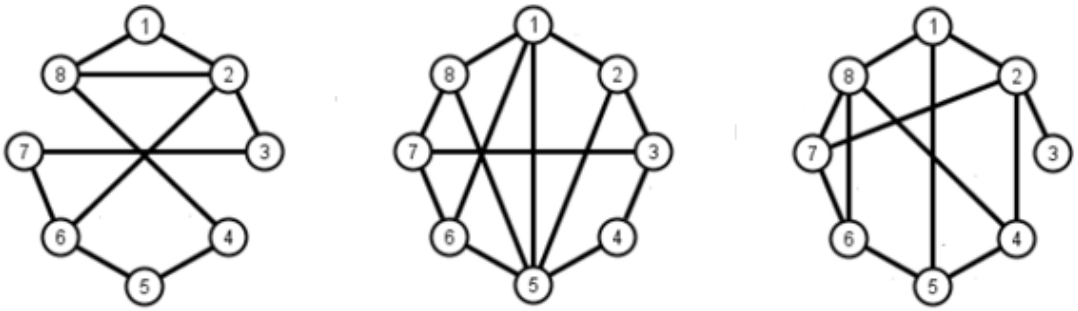
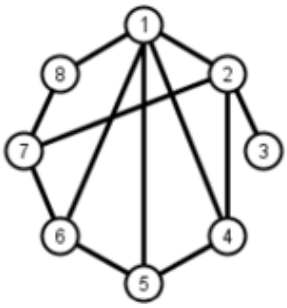


4 5 6



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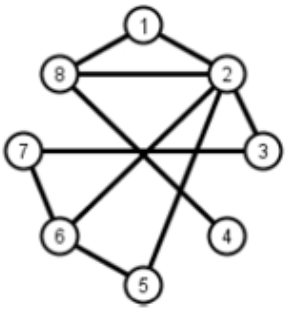

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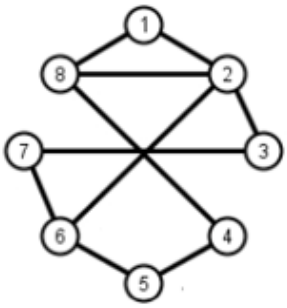

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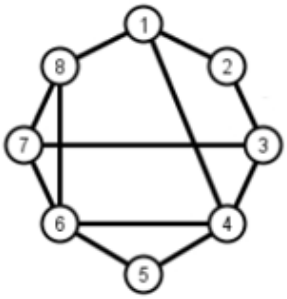

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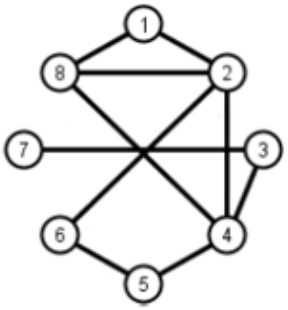
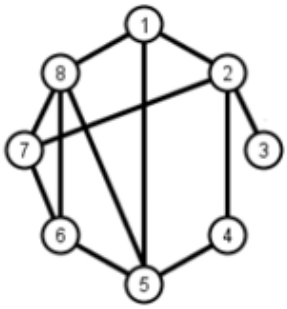
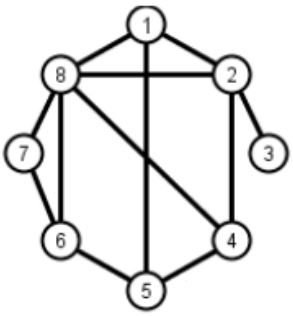


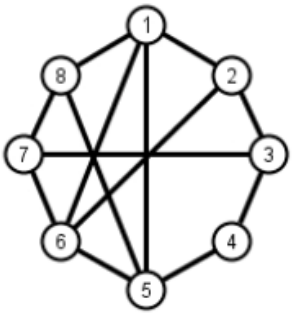
11



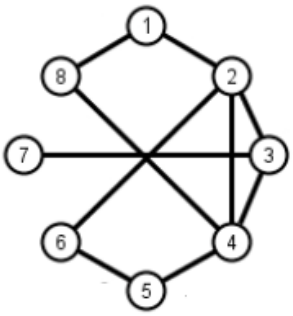
12



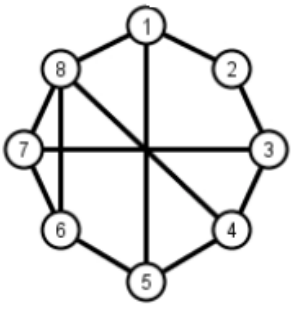
13



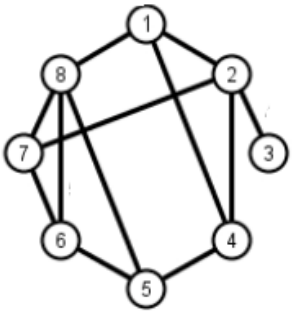
14



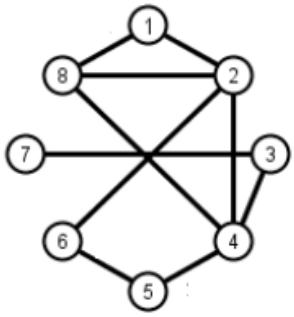
15



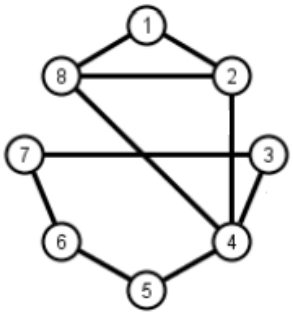
16



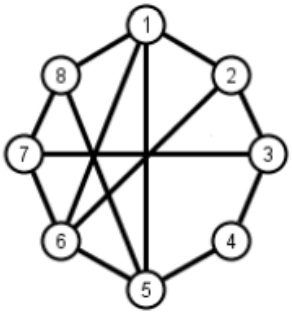
17



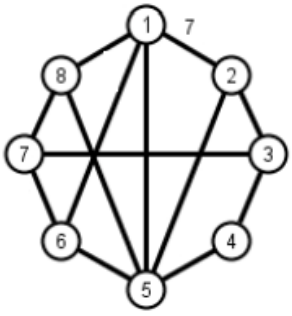
18



19



20



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БӨЖ 14. Алфавиттік кодтау. Тиімді кодтау

1. Элементар кодтарының ұзындықтар тізбегі төмендегідей берілген екілік префиксті код құрыңыз:

1. $L = (2, 2, 2, 5, 6, 7)$
2. $L = (3, 3, 3, 4, 4, 4)$
3. $L = (3, 4, 4, 5, 5, 5)$
4. $L = (2, 2, 3, 4, 5, 6)$
5. $L = (3, 4, 5, 6, 6, 7)$
6. $L = (2, 2, 3, 3, 3, 4)$
7. $L = (1, 2, 5, 6, 7, 7)$
8. $L = (2, 3, 4, 4, 5, 5)$
9. $L = (3, 4, 5, 5, 6, 6)$
10. $L = (2, 3, 4, 5, 6, 6)$
11. $L = (2, 3, 3, 4, 4, 4)$
12. $L = (1, 2, 3, 4, 5, 6)$
13. $L = (1, 2, 4, 4, 5, 6)$
14. $L = (3, 3, 4, 5, 5, 5)$
15. $L = (3, 4, 4, 4, 5, 5)$
16. $L = (2, 3, 4, 5, 6, 7)$
17. $L = (3, 4, 4, 4, 4, 5)$
18. $L = (1, 3, 4, 4, 5, 6)$
19. $L = (2, 3, 4, 4, 4, 4)$
20. $L = (2, 2, 3, 3, 4, 4)$

2. Көрсетілген ықтималдықтар үлестірімі үшін Фано және Хаффман алгоритмдерін қолдана отырып екілік код құрыңыз. Олардың тиімділігін салыстырыңыз:

1. $P = (0,37;\ 0,13;\ 0,14;\ 0,19;\ 0,11;\ 0,06)$
2. $P = (0,06;\ 0,32;\ 0,17;\ 0,18;\ 0,03;\ 0,24)$
3. $P = (0,62;\ 0,23;\ 0,09;\ 0,01;\ 0,03;\ 0,02)$
4. $P = (0,58;\ 0,17;\ 0,14;\ 0,07;\ 0,02;\ 0,02)$
5. $P = (0,55;\ 0,01;\ 0,12;\ 0,04;\ 0,12;\ 0,16)$
6. $P = (0,44;\ 0,08;\ 0,24;\ 0,09;\ 0,01;\ 0,14)$
7. $P = (0,55;\ 0,18;\ 0,07;\ 0,11;\ 0,04;\ 0,05)$
8. $P = (0,51;\ 0,03;\ 0,14;\ 0,07;\ 0,13;\ 0,12)$
9. $P = (0,54;\ 0,07;\ 0,13;\ 0,05;\ 0,06;\ 0,15)$
10. $P = (0,44;\ 0,26;\ 0,01;\ 0,18;\ 0,01;\ 0,1)$
11. $P = (0,62;\ 0,08;\ 0,02;\ 0,01;\ 0,03;\ 0,24)$
12. $P = (0,04;\ 0,3;\ 0,17;\ 0,3;\ 0,03;\ 0,16)$
13. $P = (0,45;\ 0,01;\ 0,26;\ 0,17;\ 0,03;\ 0,08)$
14. $P = (0,06;\ 0,44;\ 0,31;\ 0,03;\ 0,04;\ 0,12)$
15. $P = (0,28;\ 0,32;\ 0,13;\ 0,18;\ 0,06;\ 0,03)$
16. $P = (0,51;\ 0,16;\ 0,1;\ 0,13;\ 0,06;\ 0,04)$
17. $P = (0,6;\ 0,09;\ 0,12;\ 0,02;\ 0,08;\ 0,09)$
18. $P = (0,66;\ 0,05;\ 0,06;\ 0,01;\ 0,1;\ 0,12)$
19. $P = (0,05;\ 0,63;\ 0,05;\ 0,13;\ 0,06;\ 0,08)$
20. $P = (0,41;\ 0,28;\ 0,03;\ 0,17;\ 0,07;\ 0,04)$

БӨЖ 15. Қателерді анықтайтын және түзететін кодтар. Хэмминг коды

1. Көрсетілген хабарлама үшін Хэмминг әдісі бойынша кодтық сөз құрыңыз:

1. $\alpha = 10000$
2. $\alpha = 01000$
3. $\alpha = 11000$
4. $\alpha = 00100$
5. $\alpha = 10100$
6. $\alpha = 01100$
7. $\alpha = 11100$
8. $\alpha = 00010$
9. $\alpha = 10010$
10. $\alpha = 01010$
11. $\alpha = 11010$
12. $\alpha = 00110$
13. $\alpha = 10110$
14. $\alpha = 01110$
15. $\alpha = 11110$
16. $\alpha = 00001$
17. $\alpha = 10001$
18. $\alpha = 01001$
19. $\alpha = 11001$
20. $\alpha = 00101$

2. Байланыс каналы бойынша α хабарламасы үшін Хэмминг әдісімен құрылған кодтық сөз жіберілді. Сөзді бірден артық емес разрядта бұрмалайтын байланыс каналы бойынша жібергеннен кейін β сөзі алынды. Бастапқы хабарламаны қалпына келтіріңіз.

1. $\beta = 100000000$
2. $\beta = 001000000$
3. $\beta = 111000000$
4. $\beta = 010100000$
5. $\beta = 101100000$

6. $\beta = 000010000$
7. $\beta = 110010000$
8. $\beta = 011010000$
9. $\beta = 100110000$
10. $\beta = 001110000$
11. $\beta = 111110000$
12. $\beta = 010001000$
13. $\beta = 101001000$
14. $\beta = 000101000$
15. $\beta = 110101000$
16. $\beta = 011101000$
17. $\beta = 100011000$
18. $\beta = 001011000$
19. $\beta = 111011000$
20. $\beta = 010111000$