BAB V

KESIMPULAN

Berdasarkan hasil analisis dan pembahasan diperoleh beberapa kesimpulan sebagai berikut :

1. model matematika pada sistem produksi roti Happy Bakery persamaan interval waktu untuk unit produksi P_i, $i = 1, 2, 3, .., 9$ mulai bekerja saat ke - $(k+1)$ sebagai berikut :

$$x_1(k+1) = max([5,7]\overline{+}x_1(k), [2,3]\overline{+}u(k+1)),$$

$$x_2(k+1) = max([15,21]\overline{+}x_1(k), [7,10]\overline{+}x_2(k), [12,17]\overline{+}u(k+1)),$$

$$x_3(k+1) = max([29,41]\overline{+}x_1(k), [21,30]\overline{+}x_2(k), [13,15]\overline{+}x_3(k), [26,37]\overline{+}u(k+1)),$$

$$x_4(k+1) = max([44,59]\overline{+}x_1(k), [36,48]\overline{+}x_2(k), [28,33]\overline{+}x_3(k), [5,6]\overline{+}x_4(k), [41,55]\overline{+}u(k+1)),$$

$$x_5(k+1) = max([44,59]\overline{+}x_1(k), [36,48]\overline{+}x_2(k), [28,33]\overline{+}x_3(k), [5,6]\overline{+}x_5(k), [41,55]\overline{+}u(k+1)),$$

$$x_6(k+1) = max([44,59]\overline{+}x_1(k), [36,48]\overline{+}x_2(k), [28,33]\overline{+}x_3(k), [5,6]\overline{+}x_6(k), [41,55]\overline{+}u(k+1)),$$

$$x_7(k+1) = max([54,71]\overline{+}x_1(k), [46,60]\overline{+}x_2(k), [38,45]\overline{+}x_3(k), [15,18]\overline{+}x_4(k), [15,18]\overline{+}x_5(k), [15,18]\overline{+}x_6(k), [50,60]\overline{+}x_7(k), [51,67]\overline{+}u(k+1)),$$

$$
\begin{aligned}
x_8(k+1) &= max([109,138]\overline{+}x_1(k),[101,127]\overline{+}x_2(k),[93,112]\overline{+}\\
&\quad x_3(k),[70,85]\overline{+}x_4(k),[70,85]\overline{+}x_5(k),[70,85]\overline{+}x_6(k),\\
&\quad [105,127]\overline{+}x_7(k),[8,10]\overline{+}x_8(k),[106,134]\overline{+}u(k+1)),\\
x_9(k+1) &= max([127,161]\overline{+}x_1(k),[119,150]\overline{+}x_2(k),[111,135]\overline{+}\\
&\quad x_3(k),[88,108]\overline{+}x_4(k),[88,108]\overline{+}x_5(k),[88,108]\overline{+}\\
&\quad x_6(k),[123,150]\overline{+}x_7(k),[26,33]\overline{+}x_8(k),15,20\overline{+}x_9(k),\\
&\quad [124,157]\overline{+}u(k+1)),\\
y(k) &= d_9\overline{+}t_{12}\overline{+}x_9(k) = [15,20]\overline{+}x_9(k).
\end{aligned}
\tag{5.0.1}
$$

Persamaan 5.0.1 dengan menggunakan operasi aljabar max-plus dapat ditulis sebagai berikut :

$$
\begin{aligned}
x_1(k+1) &= ([5,7]\overline{\otimes}x_1(k))\overline{\oplus}([2,3]\overline{\otimes}u(k+1)),\\
x_2(k+1) &= ([15,21]\overline{\otimes}x_1(k))\overline{\oplus}[7,10]\overline{\otimes}x_2(k))\overline{\oplus}([12,17]\overline{\otimes}u(k+1)),\\
x_3(k+1) &= ([29,41]\overline{\otimes}x_1(k))\overline{\oplus}([21,30]\overline{\otimes}x_2(k))\overline{\oplus}([13,15]\overline{\otimes}x_3(k))\\
&\quad \overline{\oplus}([26,37]\overline{\otimes}u(k+1)),\\
x_4(k+1) &= ([44,59]\overline{\otimes}x_1(k))\overline{\oplus}([36,48]\overline{\otimes}x_2(k))\overline{\oplus}([28,33]\overline{\otimes}x_3(k))\\
&\quad \overline{\oplus}([5,6]\overline{\otimes}x_4(k))\overline{\oplus}([41,55]\overline{\otimes}u(k+1)),\\
x_5(k+1) &= ([44,59]\overline{\otimes}x_1(k))\overline{\oplus}([36,48]\overline{\otimes}x_2(k))\overline{\oplus}([28,33]\overline{\otimes}x_3(k))\\
&\quad \overline{\oplus}([5,6]\overline{\otimes}x_5(k))\overline{\oplus}([41,55]\overline{\otimes}u(k+1)),
\end{aligned}
$$

$$
\begin{aligned}
x_6(k+1) &= ([44,59]\overline{\otimes}x_1(k))\overline{\oplus}([36,48]\overline{+}x_2(k))\overline{\oplus}([28,33]\overline{\otimes}x_3(k)) \\
&\quad \overline{\oplus}([5,6]\overline{\otimes}x_6(k))\overline{\oplus}([41,55]\overline{\otimes}u(k+1)), \\
x_7(k+1) &= ([54,71]\overline{\otimes}x_1(k))\overline{\oplus}([46,60]\overline{\otimes}x_2(k))\overline{\oplus}([38,45]\overline{\otimes}x_3(k)) \\
&\quad \overline{\oplus}([15,18]\overline{\otimes}x_4(k))\overline{\oplus}([15,18]\overline{\otimes}x_5(k))\overline{\oplus}([15,18]\overline{\otimes}x_6(k))\overline{\oplus}[50,60] \\
&\quad \overline{\otimes}x_7(k))\overline{\oplus}([51,67]\overline{\otimes}u(k+1)), \\
x_8(k+1) &= ([109,138]\overline{\otimes}x_1(k))\overline{\oplus}([101,127]\overline{\otimes}x_2(k))\overline{\oplus}([93,112]\overline{\otimes} \\
&\quad x_3(k))\overline{\oplus}([70,85]\overline{\otimes}x_4(k))\overline{\oplus}([70,85]\overline{\otimes}x_5(k))\overline{\oplus}([70,85]\overline{\otimes}x_6(k)) \\
&\quad \overline{\oplus}([105,127]\overline{\otimes}x_7(k))\overline{\oplus}([8,10]\overline{\otimes}x_8(k))\overline{\oplus}([106,134]\overline{\otimes}u(k+1)), \\
x_9(k+1) &= ([127,161]\overline{\otimes}x_1(k))\overline{\oplus}([119,150]\overline{\otimes}x_2(k))\overline{\oplus}[111,135]\overline{\otimes} \\
&\quad x_3(k))\overline{\oplus}([88,108]\overline{\otimes}x_4(k))\overline{\oplus}([88,108]\overline{\otimes}x_5(k))\overline{\oplus}([88,108]\overline{\otimes} \\
&\quad x_6(k))\overline{\oplus}([123,150]\overline{\otimes}x_7(k))\overline{\oplus}([26,33]\overline{\otimes}x_8(k))\overline{\oplus}([15,20]\overline{\otimes}x_9(k)) \\
&\quad ([124,157]\overline{\otimes}u(k+1)), \\
y(k) &= [15,20]\overline{\otimes}x_9(k). \qquad (5.0.2)
\end{aligned}
$$

Persamaan 5.0.2 dapat diubah menjadi persamaan pada SLMII, sebagai berikut:

$$
\begin{aligned}
\mathbf{x}(k+1) &= A\overline{\otimes}\mathbf{x}(k)\overline{\oplus}B\overline{\otimes}u(k+1), \\
y(k) &= C\overline{\otimes}\mathbf{x}(k), \qquad (5.0.3)
\end{aligned}
$$

untuk $k = 1, 2, 3,$,dengan:

$$A = \begin{bmatrix} [5,7] & [\varepsilon,\varepsilon] & [\varepsilon,\varepsilon] & [\varepsilon,\varepsilon] & [\varepsilon,\varepsilon] & [\varepsilon,\varepsilon] & [\varepsilon,\varepsilon] & [\varepsilon,\varepsilon] & [\varepsilon,\varepsilon] \\ [15,21] & [7,10] & [\varepsilon,\varepsilon] & [\varepsilon,\varepsilon] & [\varepsilon,\varepsilon] & [\varepsilon,\varepsilon] & [\varepsilon,\varepsilon] & [\varepsilon,\varepsilon] & [\varepsilon,\varepsilon] \\ [29,41] & [21,30] & [13,15] & [\varepsilon,\varepsilon] & [\varepsilon,\varepsilon] & [\varepsilon,\varepsilon] & [\varepsilon,\varepsilon] & [\varepsilon,\varepsilon] & [\varepsilon,\varepsilon] \\ [44,59] & [36,48] & [28,33] & [5,6] & [\varepsilon,\varepsilon] & [\varepsilon,\varepsilon] & [\varepsilon,\varepsilon] & [\varepsilon,\varepsilon] & [\varepsilon,\varepsilon] \\ [44,59] & [36,48] & [28,33] & [\varepsilon,\varepsilon] & [5,6] & [\varepsilon,\varepsilon] & [\varepsilon,\varepsilon] & [\varepsilon,\varepsilon] & [\varepsilon,\varepsilon] \\ [44,59] & [36,48] & [28,33] & [\varepsilon,\varepsilon] & [\varepsilon,\varepsilon] & [5,6] & [\varepsilon,\varepsilon] & [\varepsilon,\varepsilon] & [\varepsilon,\varepsilon] \\ [54,71] & [46,60] & [38,45] & [15,18] & [15,18] & [15,18] & [50,60] & [\varepsilon,\varepsilon] & [\varepsilon,\varepsilon] \\ [109,138] & [101,127] & [93,112] & [70,85] & [70,85] & [70,85] & [105,127] & [8,10] & [\varepsilon,\varepsilon] \\ [127,161] & [119,150] & [111,135] & [88,108] & [88,108] & [88,108] & [123,150] & [26,33] & [15,20] \end{bmatrix},$$

$$B = \begin{bmatrix} [2,3] \\ [12,17] \\ [26,37] \\ [41,55] \\ [41,55] \\ [41,55] \\ [51,67] \\ [106,134] \\ [124,157] \end{bmatrix},$$

$$C = \begin{bmatrix} [\varepsilon,\varepsilon] & [\varepsilon,\varepsilon] & [\varepsilon,\varepsilon] & [\varepsilon,\varepsilon] & [\varepsilon,\varepsilon] & [\varepsilon,\varepsilon] & [\varepsilon,\varepsilon]n & [\varepsilon,\varepsilon] & [15,20] \end{bmatrix},$$

$$\mathbf{x}(k) = \begin{bmatrix} x_1(k) & x_2(k) & x_3(k & ,x_4(k) & x_5(k) & x_6(k) & x_7(k) & x_8(k) & x_9(k) \end{bmatrix}^T,$$

$$\mathbf{x}(0) = \begin{bmatrix} [0,0] & [\varepsilon,\varepsilon] & [\varepsilon,\varepsilon] & [\varepsilon,\varepsilon] & [\varepsilon,\varepsilon] & [\varepsilon,\varepsilon] & [\varepsilon,\varepsilon] & [\varepsilon,\varepsilon] & [\varepsilon,\varepsilon] \end{bmatrix}^T.$$

Menggunakan persamaan 5.0.3 dapat dibentuk persamaan berikut :

(a) untuk batas bawah :

$$\underline{\mathbf{x}}(k+1) = \underline{A} \otimes \underline{\mathbf{x}}(k) \oplus \underline{B} \otimes \underline{u}(k+1),$$

$$\underline{y}(k) = \underline{C} \otimes \underline{\mathbf{x}}(k), \tag{5.0.4}$$

untuk $k = 1, 2, 3$, dengan :

$$\underline{A} = \begin{bmatrix} 5 & \varepsilon & \varepsilon & \varepsilon & \varepsilon & \varepsilon & \varepsilon & \varepsilon & \varepsilon \\ 15 & 7 & \varepsilon & \varepsilon & \varepsilon & \varepsilon & \varepsilon & \varepsilon & \varepsilon \\ 29 & 21 & 13 & \varepsilon & \varepsilon & \varepsilon & \varepsilon & \varepsilon & \varepsilon \\ 44 & 36 & 28 & 5 & \varepsilon & \varepsilon & \varepsilon & \varepsilon & \varepsilon \\ 44 & 36 & 28 & \varepsilon & 5 & \varepsilon & \varepsilon & \varepsilon & \varepsilon \\ 44 & 36 & 28 & \varepsilon & \varepsilon & 5 & \varepsilon & \varepsilon & \varepsilon \\ 54 & 46 & 38 & 15 & 15 & 15 & 50 & \varepsilon & \varepsilon \\ 109 & 101 & 93 & 70 & 70 & 70 & 105 & 8 & \varepsilon \\ 127 & 119 & 111 & 88 & 88 & 88 & 123 & 26 & 15 \end{bmatrix},$$

$$\underline{B} = \begin{bmatrix} 2 \\ 12 \\ 26 \\ 41 \\ 41 \\ 41 \\ 51 \\ 106 \\ 124 \end{bmatrix}, \underline{C} = \begin{bmatrix} \varepsilon & \varepsilon & \varepsilon & \varepsilon & \varepsilon & \varepsilon & \varepsilon & \varepsilon & 15 \end{bmatrix},$$

$$\underline{\mathbf{x}}(k) = \begin{bmatrix} \underline{\mathrm{x}}_1(k) & \underline{\mathrm{x}}_2(k) & \ldots & \underline{\mathrm{x}}_9(k) \end{bmatrix}^T, \text{ dan } \underline{\mathbf{x}}(0) = \begin{bmatrix} 0 & \varepsilon & \varepsilon & \varepsilon & \varepsilon & \varepsilon & \varepsilon & \varepsilon & \varepsilon \end{bmatrix}^T,$$

(b) untuk batas atas :

$$\overline{x}(k+1) = \overline{A} \otimes \overline{x}(k) \oplus \overline{B} \otimes \overline{u}(k+1),$$

$$\overline{y}(k) = \overline{C} \otimes \overline{x}(k), \tag{5.0.5}$$

untuk $k = 1, 2, 3$, dengan :

$$\overline{A} = \begin{bmatrix} 7 & \varepsilon & \varepsilon & \varepsilon & \varepsilon & \varepsilon & \varepsilon & \varepsilon & \varepsilon \\ 21 & 10 & \varepsilon & \varepsilon & \varepsilon & \varepsilon & \varepsilon & \varepsilon & \varepsilon \\ 41 & 30 & 15 & \varepsilon & \varepsilon & \varepsilon & \varepsilon & \varepsilon & \varepsilon \\ 59 & 48 & 33 & 6 & \varepsilon & \varepsilon & \varepsilon & \varepsilon & \varepsilon \\ 59 & 48 & 33 & \varepsilon & 6 & \varepsilon & \varepsilon & \varepsilon & \varepsilon \\ 59 & 48 & 33 & \varepsilon & \varepsilon & 6 & \varepsilon & \varepsilon & \varepsilon \\ 71 & 60 & 45 & 18 & 18 & 18 & 60 & \varepsilon & \varepsilon \\ 138 & 127 & 112 & 85 & 85 & 85 & 127 & 10 & \varepsilon \\ 161 & 150 & 135 & 108 & 108 & 108 & 150 & 33 & 20 \end{bmatrix},$$

$$\overline{B} = \begin{bmatrix} 3 \\ 17 \\ 37 \\ 55 \\ 55 \\ 55 \\ 67 \\ 134 \\ 157 \end{bmatrix}, \overline{C} = \begin{bmatrix} \varepsilon & \varepsilon & \varepsilon & \varepsilon & \varepsilon & \varepsilon & \varepsilon & \varepsilon & 20 \end{bmatrix},$$

$$\overline{x}(\mathrm{k})=\begin{bmatrix} \overline{x}_1(k) & \overline{x}_2(k) & \ldots & \overline{x}_9(k) \end{bmatrix}^T, \text{dan } \overline{x}(0)=\begin{bmatrix} 0 & \varepsilon & \varepsilon & \varepsilon & \varepsilon & \varepsilon & \varepsilon & \varepsilon & \varepsilon \end{bmatrix}^T.$$

2. menggunakan SLMII diperoleh jadwal produksi tercepat dan terlama produk Roti Happy Bakery. Berdasarkan jadwal tersebut kegiatan produksi roti yang dimulai dari pukul 08.00-16.00 dapat memproduksi tiga kali produksi, ketika kegiatan produksi dilakukan secara maksimal dan kontinu. Jadwal terbaik yang digunakan untuk produksi roti pada Happy Bakery adalah sebagai berikut :

Proses Kegiatan Produksi	Waktu Memulai Produksi (WIB)		
		Produksi Ke	
	1	2	3
Pencampuran Bahan	08.00	10.19	12.38
Penggilingan	08.10	10.29	12.48
Pembentukan Roti	08.24	10.43	13.02
Pengisian Coklat	08.39	10.58	13.17
Pengisian Kelapa	08.39	10.58	13.17
Pengisian Selai Nanas	08.39	10.58	13.17
Pengembangan Adonan	08.49	11.08	13.27
Pemanganggan	09.44	12.03	14.22
Pembungkusan	10.02	12.21	14.40
Produk Siap Jual	10.17	12.36	14.55

.