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161ENG041043

Electrical Electronics,

Assignment 7.

finite difference form.

$$\frac{T_{i,j+1} - T_{i,j}}{\Delta t} = C \times \left(\frac{T_{i+1,j} - 2T_{i,j} + T_{i-1,j}}{(\Delta x)^2} \right)$$

where $C = 2.2 \text{ cm}^2/\text{hr}$

$$r = \frac{C \times \Delta t}{\Delta x^2} ; \Delta t = 0.02 \text{ hr} \quad \Delta x = 0.3 \text{ cm}$$

$$r = \frac{2.2 \times 0.02}{0.3^2} = 0.48889$$

$r \approx 0.49$ cross multiplying.

$$\text{Subs } T_{i,j+1} - T_{i,j} = \frac{C \Delta t}{\Delta x^2} (T_{i+1,j} - 2T_{i,j} + T_{i-1,j})$$

$$T_{i,j+1} - T_{i,j} = 0.48889 (T_{i+1,j} - 2T_{i,j} + T_{i-1,j})$$

$$T_{i,j+1} - T_{i,j} = r (T_{i+1,j}) - 2r T_{i,j} + r T_{i-1,j}$$

$$T_{i,j+1} = r T_{i+1,j} + T_{i,j} - 2r T_{i,j} + r T_{i-1,j}$$

$$T_{i,j+1} = r T_{i+1,j} + T_{i,j} (1 - 2r) + r T_{i-1,j}$$

where $r = 0.48889$.

$$T(x, 0) = 3x^2$$

which means for any value of $t = 0$

$$T = 3x^2.$$

FOR THE FIRST ROW

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where $x=0, t=0$

$$T(0,0) = 3x^2 = 3 \times 0^2 = 0 \rightarrow x_0 \quad T_{0,0}$$

where $x=0.3 \text{ cm}, t=0$

$$T(0.3,0) = 3x^2 = 3 \times (0.3)^2 = 0.27 \rightarrow x_1 \quad T_{1,0}$$

where $x=0.6 \text{ cm}$

$$T(0.6,0) = 3x^2 = 3 \times (0.6)^2 = 1.08 \rightarrow x_2 \quad T_{2,0}$$

where $x=0.9 \text{ cm}$

$$T(0.9,0) = 3x^2 = 3 \times (0.9)^2 = 2.43 \rightarrow x_3 \quad T_{3,0}$$

where $x=1.2 \text{ cm}$

$$T(1.2,0) = 3x^2 = 3 \times (1.2)^2 = 4.32 \rightarrow x_4 \quad T_{4,0}$$

where $x=1.5 \text{ cm}$

$$T(1.5,0) = 3x^2 = 3 \times (1.5)^2 = 6.75 \quad T_{5,0}$$

where $x=1.8 \text{ cm}$

$$T(1.8,0) = 3x^2 = 3 \times 1.8^2 = 9.72 \quad T_{6,0}$$

where $x=2.1 \text{ cm}$

$$T(2.1,0) = 3x^2 = 3 \times 2.1^2 = 13.23 \rightarrow x_7 \quad T_{7,0}$$

where $x=2.4 \text{ cm}$

$$T(2.4,0) = 3x^2 = 3 \times 2.4^2 = 17.28 \rightarrow x_8 \quad T_{8,0}$$

where $x=2.7 \text{ cm}$

$$T(2.7,0) = 3x^2 = 3 \times 2.7^2 = 21.87 \quad T_{9,0}$$

where $x=3.0 \text{ cm}$

$$T(3.0,0) = 3x^2 = 3 \times 3.0^2 = 27 \quad T_{10,0}$$

where $x=3.3 \text{ cm}$

$$T(3.3,0) = 3x^2 = 3 \times 3.3^2 = 32.67 \quad T_{11,0}$$

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where $x = 3.6$ cm

$$T(3.6, 0) = 3x^2 = 3 \times 3.6^2 = 38.88 \quad T_{12,0}$$

where $x = 3.9$ cm

$$T(3.9, 0) = 3x^2 = 3 \times (3.9)^2 = 45.63 \quad T_{13,0}$$

where $x = 4.2$ cm

$$T(4.2, 0) = 3x^2 = 3 \times 4.2^2 = 52.92 \quad T_{14,0}$$

where $x = 4.5$ cm

$$T(4.5, 0) = 3x^2 = 3 \times 4.5^2 = 60.75 \quad T_{15,0}$$

where $x = 4.8$ cm

$$T(4.8, 0) = 3x^2 = 3 \times 4.8^2 = 69.12 \quad T_{16,0}$$

where $x = 5.1$ cm

$$T(5.1, 0) = 3x^2 = 3 \times 5.1^2 = 78.03 \quad T_{17,0}$$

where $x = 5.4$ cm

$$T(5.4, 0) = 3x^2 = 3 \times 5.4^2 = 87.48 \quad T_{18,0}$$

where $x = 5.7$ cm

$$T(5.7, 0) = 3x^2 = 3 \times 5.7^2 = 97.47 \quad T_{19,0}$$

where $x = 6$ cm

$$T(6, 0) = 3x^2 = 3 \times 6^2 = 108 \quad T_{20,0}$$

For the second row

$$T_{i,j+1} = r T_{i+1,j} + (1-2r) T_{i,j} + r T_{i-1,j}$$

where $i \geq 1, j \geq 0$

$$T_{1,1} = r(T_{2,0}) + (1-2r)T_{1,0} + r T_{0,0}$$

$$= 0.49(1.08) + 1-2(0.49)(0.27) + 0.49(0)$$

$$T_{1,1} = 0.5346$$

where $i=2, j=0$

$$\begin{aligned} T_{2,1} &= r T_{3,0} + (1-2r) T_{2,0} + r T_{1,0} \\ &= 0.49(2.43) + 0.02(1.08) + 0.49(0.27) \end{aligned}$$

$$T_{2,1} = 1.3446$$

where $i=3, j=0$

$$\begin{aligned} T_{3,1} &= 0.49 T_{4,0} + 0.02 T_{3,0} + 0.49 T_{2,0} \\ &= 0.49(4.32) + 0.02(2.43) + 0.49(1.08) \end{aligned}$$

$$T_{3,1} = 2.6946$$

where $i=4, j=0$

$$\begin{aligned} T_{4,1} &= 0.49 T_{5,0} + 0.02 T_{4,0} + 0.49 T_{3,0} \\ &= 0.49(6.75) + 0.02(4.32) + 0.49(2.43) \end{aligned}$$

$$T_{4,1} = 4.5846$$

where $i=5, j=0$

$$\begin{aligned} T_{5,1} &= 0.49 T_{6,0} + 0.02 T_{5,0} + 0.49 T_{4,0} \\ &= 0.49(9.72) + 0.02(6.75) + 0.49(4.32) \end{aligned}$$

$$T_{5,1} = 7.0146$$

where $i=6, j=0$

$$\begin{aligned} T_{6,1} &= 0.49(T_{7,0}) + 0.02 T_{6,0} + T_{5,0} \\ &= 0.49(13.23) + 0.02(9.72) + 0.49(6.75) \end{aligned}$$

$$T_{6,1} = 9.9846$$

where $i=7, j=0$

$$\begin{aligned} T_{7,1} &= 0.49(T_{8,0}) + 0.02 T_{7,0} + 0.49 T_{6,0} \\ &= 0.49(17.28) + 0.02(13.23) + 0.49(9.72) = \end{aligned}$$

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Math Assignment + Cont'd

$$T_{i,j+1} = r T_{i+1,j} + (1-2r) T_{i,j} + r T_{i-1,j}$$

$$T_{7,1} = 13.4946$$

$$\text{where } r = 0.49 \quad (1-2r) = 0.02$$

$$\text{where } i = 8, j = 0$$

$$\begin{aligned} T_{8,1} &= 0.49(T_{8,0}) + 0.02 T_{8,0} + 0.49(T_{7,0}) \\ &= 0.49(21.87) + 0.02(17.18) + 0.49(13.23) \end{aligned}$$

$$T_{8,1} = 17.5446$$

$$\text{where } i = 9, j = 0$$

$$\begin{aligned} T_{9,1} &= 0.49 T_{10,0} + 0.02 T_{9,0} + 0.49 T_{8,0} \\ &= 0.49(27) + 0.02(21.87) + 0.49(17.28) \end{aligned}$$

$$T_{9,1} = 22.1346$$

$$\text{where } i = 10, j = 0$$

$$\begin{aligned} T_{10,1} &= 0.49 T_{11,0} + 0.02 T_{10,0} + 0.49 T_{9,0} \\ &= 0.49(32.67) + 0.02(27) + 0.49(21.87) \end{aligned}$$

$$T_{10,1} = 27.2646$$

$$\text{where } i = 11, j = 0$$

$$\begin{aligned} T_{11,1} &= 0.49 T_{12,0} + 0.02 T_{11,0} + 0.49 T_{10,0} \\ &= 0.49(38.88) + 0.02(38.87) + 0.49(27) \end{aligned}$$

$$T_{11,1} = 32.9346$$

$$\text{where } i = 12, j = 0$$

$$T_{12,1} = 0.49 T_{13,0} + 0.02 T_{12,0} + 0.49 T_{11,0}$$

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$$T_{12,1} = 0.49(45.63) + 0.02(38.88) + 0.49(32.67) \\ = 39.1446$$

where $i=13, j=0$

$$T_{13,1} = 0.49T_{14,0} + 0.02T_{13,0} + 0.49T_{12,0} \\ = 0.49(52.92) + 0.02(45.63) + 0.49(38.88)$$

$$T_{13,1} = 45.8946$$

where $i=14, j=0$

$$T_{14,1} = 0.49T_{15,0} + 0.02T_{14,0} + 0.49T_{13,0} \\ = 0.49(60.75) + 0.02(52.92) + 0.49(45.63)$$

$$T_{14,1} = 53.1846$$

where $i=15, j=0$

$$T_{15,1} = 0.49T_{16,0} + 0.02T_{15,0} + 0.49T_{14,0} \\ = 0.49(69.12) + 0.02(60.75) + 0.49(52.92)$$

$$T_{15,1} = 61.0146$$

where $i=16, j=0$

$$T_{16,1} = 0.49T_{17,0} + 0.02T_{16,0} + 0.49T_{15,0} \\ = 0.49(78.03) + 0.02(69.12) + 0.49(60.75)$$

$$T_{16,1} = 69.3846$$

where $i=17, j=0$

$$T_{17,1} = 0.49T_{18,0} + 0.02T_{17,0} + 0.49T_{16,0} \\ = 0.49(87.48) + 0.02(78.03) + 0.49(69.12)$$

$$T_{17,1} = 78.2946$$

where $i=18, j=0$

$$T_{18,1} = 0.49T_{19,0} + 0.02T_{18,0} + 0.49T_{17,0}$$

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$$T_{18,1} = 0.49(97.47) + 0.02(87.48) + 0.49(28.03)$$

$$\text{where } i=19, j=0$$

$$T_{19,1} = 0.49T_{20,0} + 0.02T_{19,0} + 0.49T_{18,0}$$

$$= 0.49(108) + 0.02(97.49) + 0.49(87.48)$$

$$T_{19,1} = 97.7346$$

$$T_{20,1} = 108$$

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
0	0.534	1.3346	2.6946	4.5846	7.0146	9.9846	13.4946	17.5446	22.1346	27.2646	32.9346	39.1446	45.8946	53.1846	61.0146	69.3846	78.2946	87.7446	97.7346	108
0	0.27	1.08	2.43	4.32	6.75	9.72	13.23	17.28	21.87	27	32.67	38.88	45.63	52.92	60.75	69.12	78.03	87.48	97.47	108
0	0.534	1.3346	2.6946	4.5846	7.0146	9.9846	13.4946	17.5446	22.1346	27.2646	32.9346	39.1446	45.8946	53.1846	61.0146	69.3846	78.2946	87.7446	97.7346	108