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Electrical/Electronics
Assignment 7

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

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

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

$$r = \frac{2.2 \times 0.02}{0.3^2} = 0.488889$$

$r \approx 0.49$ cross multiplying

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

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

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

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

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

where $r = 0.48889$

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

Which means for any value of $t \geq 0$

$$T = 3x^2$$

for the first row

when $x = 0.5$ cm
 $T(0.5, 0) = 2x^2 + 3x(0)^2 = 0.5$ T_{0,0}
 when $x = 0.8$ cm
 $T(0.8, 0) = 2x^2 + 3x(0)^2 = 1.28$ T_{0,0}
 when $x = 1.0$ cm
 $T(1.0, 0) = 2x^2 + 3x(0)^2 = 2.0$ T_{0,0}
 when $x = 1.2$ cm
 $T(1.2, 0) = 2x^2 + 3x(0)^2 = 2.88$ T_{0,0}
 when $x = 1.5$ cm
 $T(1.5, 0) = 2x^2 + 3x(0)^2 = 4.5$ T_{0,0}
 when $x = 1.8$ cm
 $T(1.8, 0) = 2x^2 + 3x(0)^2 = 7.2$ T_{0,0}
 when $x = 2.0$ cm
 $T(2.0, 0) = 2x^2 + 3x(0)^2 = 8.0$ T_{0,0}
 when $x = 2.4$ cm
 $T(2.4, 0) = 2x^2 + 3x(0)^2 = 11.52$ T_{0,0}
 when $x = 2.7$ cm
 $T(2.7, 0) = 2x^2 + 3x(0)^2 = 14.58$ T_{0,0}
 when $x = 3.0$ cm
 $T(3.0, 0) = 2x^2 + 3x(0)^2 = 18.0$ T_{0,0}
 when $x = 3.3$ cm
 $T(3.3, 0) = 2x^2 + 3x(0)^2 = 21.78$ T_{0,0}

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 $i \neq 0, j \neq 0$

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

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

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

where $i=2, j=0$

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

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

where $i=3, j=0$

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

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

where $i=4, j=0$

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

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

where $i=5, j=0$

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

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

where $i=6, j=0$

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

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

where $i=7, j=0$

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

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Math assignment cont'd

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

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

where $r = 0.49$ $(1-2r) = 0.02$

where $i = 8, j = 0$

$$\begin{aligned} T_{8,1} &= 0.49(T_{9,0}) + 0.02 T_{8,0} + 0.49(T_{7,0}) \\ &= 0.49(21.87) + 0.02(17.18) + 0.49(13.23) \end{aligned}$$

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

where $i = 9, j = 0$

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

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

where $i = 10, j = 0$

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

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

where $i = 11, j = 0$

$$\begin{aligned} T_{11,1} &= 0.49 T_{12,0} + 0.02 T_{11,0} + 0.49 T_{10,0} \\ &= 0.49(38.88) + 0.02(32.67) + 0.49(27) \end{aligned}$$

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

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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