Excel for Partial Differential Equations

1. EXCEL Application (Diffusion Equation, Partial Differential Equation)

Problem

A 1-m-long, laterally insulated rod, originally at 60 , is subjected at one end

to 500 . Estimate the temperature in the rod as a function of time if the $2 \times 10^{-1} \text{m}^2/\text{s}$ ends are held at 500 and 60 ,respectively. Diffusivity is Use five displacement steps with a time of 4ks.

Solution

Using diffusion equation and differencing the PDE equation, we get

 $T_{i,j+1} = \frac{ka}{h^2} (T_{i+1,j} - 2T_{i,j} + T_{i-1,j})$ Initial condition : T(x,0)= 60 Bound condition : T(0,0)=500 T(1,0)=60

1. EXCEL window



1. EXCEL Application (Diffusion Equation of Partial Differential Equation)

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1	500	60	60	60	60	60			
2	500	148	60	60	60	60			
3	500	200,8	77,6	60	60	60			
4	500	236	98,72	63,52	60	60			
5	500	261,344	<u>119,136</u>	69,856	60,704	60			
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1. EXCEL window

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82	500	411,7451	323,5876	235,5876	147,7451	60			
83	500	411.7646	323,6191	235,6191	147,7646	60			
84	500	411,7826	323,6482	235,6482	147,7826	60			
85	500	411,7992	323,675	235,675	147,7992	60			
86	500	411,8145	323,6999	235,6999	147,8145	60			
87	500	411,8287	323,7228	235,7228	147,8287	60			
88	500	411,8418	323,744	235,744	147,8418	60			
89	500	411,8539	323,7635	235,7635	147,8539	60			
90	500	411,865	323,7816	235,7816	147,865	60			
91	500	411,8753	323,7983	235,7983	147,8753	60			
92	500	411,8849	323,8137	235,8137	147,8849	60			
93	500	411,8936	323,8279	235,8279	147,8936	60			
94	500	411,9018	323,8411	235,8411	147,9018	60			
95	500	411,9093	323,8532	235,8532	147,9093	60			
96	500	411,9162	323,8644	235,8644	147,9162	60			
97	500	411,9226	323,8748	235,8748	147,9226	60			
98	500	411,9285	323,8843	235,8843	147,9285	60			
99	500	411,934	323,8932	235,8932	147,934	60			
100	500	411,939	323,9013	235,9013	147,939	60			
101	500	411,9437	323,9089	235,9089	147,9437	60]	~
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2. EXCEL Application (Laplace Equation, Partial Differential Equation)

Problem

A 50-X 60-mm flat plate, insulated on both flat surfaces, has its edges maint-

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ained at 0, 100, 200, and 300 , in that order, going counterclockwise.
Using
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the relaxation method, determine the steady-state temperature at each grid

point, using 10-X10-mm grid.

Solution

Using Laplace equation



2. EXCEL window (Laplace Equation)

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1	250	200	200	200	200	200	150		
2	300	290	270	240	200	150	100		
3	300	280	250	220	180	130	100		
4	300	200	150	100	100	100	100		
5	300	50	50	50	50	50	100		
6	150	0	0	0	0	0	50		
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2. EXCEL window (Laplace Equation)

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2	300	290	270	240	200	150	100		
3	300	280	250	220	180	130	100		
4	300	200	150	100	100	100	100		
5	300	50	50	50	50	50	100		
6	150	0	0	0	0	0	50		
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11	250	200	200	200	200	200	150		
12	300	262.5	245	222,5	192,5	157,5	100		
13	300	260	230	192.5	162.5	132.5	100		_
14	300	195	150	130	107.5	95	100		_
15	300	137,5	62.5	50	50	62.5	100		
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2. EXCEL window

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91	250	200	200	200	200	200	150		
92	300	234,3159	202,1132	183,2214	168,3075	147,94	100		
93	300	233,7934	188,367	159.6471	139,8639	122.0291	100		
94	300	210,2882	154,7861	123,3022	106,1938	98,64613	100		
95	300	151.3656	94,23775	69,90307	60,52395	64.9509	100		
96	150	0	0	0	0	0	50		
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101	250	200	200	200	200	200	150		
102	300	<u>233,9766</u>	201,4761	182,5169	167,7563	147,5841	100		
103	300	233,2428	187,585	158,6886	139,0444	121.6125	100		
104	300	209,9863	154,0488	122,6325	105,584	98,29345	100		
105	300	151,1315	94,0137	69,51597	60,26194	64,79252	100		
106	150	0	0	0	0	0	50		
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