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17/ENG06/056
Mechanical Engineering

$$u_t - Cu_{xx} = 0$$

$$\frac{du}{dt} - C\frac{d^2u}{dx^2} = 0$$

$$\frac{du}{dt} = \frac{Cd^2u}{dx^2}$$

$$\frac{u_{i,j+1} - u_{i,j}}{\Delta t} = \frac{C\,u_{i+1,j} - 2u_{i,j} + u_{i-1,j}}{\Delta x^2}$$

$$u_{i,j+1} - u_{i,j} = \frac{C\Delta t}{\Delta x^2}\left[u_{i+1,j} - 2u_{i,j} + u_{i-1,j}\right] \cdot \Gamma_0 \quad \Delta t/\Delta x^2, C=1$$

$$u[x_0] = x^4 k$$

$\Delta x = 0.2m$, $\Delta t = 0.02$ day

for initial conditioning

At $x = 0 \longrightarrow x^4 = 0$

At $x = 0.4 \longrightarrow 0.4^4 = 0.0256$

At $x = 0.6 \longrightarrow 0.6^4 = 0.1296$

At $x = 0.8 \longrightarrow 0.8^4 = 0.4096$

At $x = 1 \longrightarrow 1^4 = 1$

$$\therefore u_{i,j+1} = u_{i,j} + r\left[u_{i+1,j} - 2u_{i,j} + u_{i-1,j}\right]$$

$$u_{i,j+1} = \Gamma u_{i-1,j} + (1-2r)\,u_{i,j} + r u_{i+1,j}$$

when $i = 1, j = 0$

$$u_{1,1} = 0.5\,u_{0,0} + 0.5\,u_{2,0}$$

$$= 0.5(0) + 0.5(0.0256)$$

$$u_{1,1} = 0.0128$$

when $i = 2, j = 0$

$$u_{2,1} = 0.5(u_{1,0}) + 0.5(u_{0,0})$$

$$= 0.5(1.6 \times 10^{-3}) + 0.5(0.1296)$$

$$u_{2,1} = 0.0656$$

$$u_{3,4} = 0.5\,(u_{2,3}) + 0.5\,(u_{4,3})$$

when $i = 4$

$$= 0.5\,(0.174) + 0.5\,(0.6576) = 0.4158$$

$$u_{4,4} = 0.5\,(u_{3,3}) + 0.5\,(u_{5,3})$$

$$= 0.5\,(0.362) + 0.681$$

for $J = 4$

when $i = 1 = u_{1,5} = 0.5\,(u_{0,4}) + 0.5\,(u_{2,4})$

$$= 0.5\,(0.2098) = 0.1049$$

when $i = 2$. $u_{2,5} = 0.5\,(u_{1,4}) + 0.5\,(u_{3,4})$

$$= 0.2514$$

when $i = 3 = 0.4454$

when $i = 4 = 0.7079$

Δt	J / Temp (4)						
0.1	5	0	0.1049	0.2514	0.4454	0.7079	1
0.08	4	0	0.087	0.2098	0.4158	0.681	1
0.06	3	0	0.0576	0.174	0.362	0.6576	1
0.04	2	0	0.0328	0.1152	0.3152	0.6008	1
0.02	1	0	0.0128	0.0656	0.2176	0.5648	1
0	0	0	0.0016	0.028	0.1296	0.4096	1
Δx.		0	0.2	0.4	0.6	0.8	
		0	1	2	3	4	5

when $i=3, j=0$ $= u_{3,1} = 0.5(u_{2,0}) + 0.5(u_{4,0})$

$= 0.5(0.0256) + 0.5(0.4096)$

$u_{3,1} = 0.2176$

when $i=4, j=0$ $\therefore u_{4,1} = 0.5(u_{3,0}) + 0.5(u_{5,0})$

$= 0.5(0.0256) + 0.5(0.4096)$

$u_{4,1} = 0.5648$

for $j=1$

when $i=1$ $\therefore u_{1,2} = 0.5(0,1) + 0.5(u_{2,1})$

$= 0.5u_{0,1} + 0.5u_{2,1} = 0 + 0.5(0.0656)$

$u_{1,2} = 0.0328$

when $i=2$ $\therefore u_{2,2} = 0.5(u_{1,1}) + 0.5(u_{3,1})$

$= 0.5(0.0128) + 0.5(0.2176)$

$u_{2,2} = 0.1152$

when $i=3$

$u_{3,2} = 0.5(u_{0,1}) + 0.5(u_{4,1})$

$0.5(0.0656) + 0.5(0.5648)$

$u_{3,2} = 0.3152$

when $i=4$

$u_{4,2} = 0.5(u_{2,1}) + 0.5(u_{5,1})$

$= 0.5(0.2176) + 0.5(1)$

$u_{4,2} = 0.6088$

for $j=2$

when $i=1$ $\therefore u_{1,3} = 0.5(u_{0,1}) + 0.5(u_{2,2})$

$= 0 + 0.5(0.1152) = 0.0576$

when $i=2$ $\therefore u_{2,3} = 0.5(u_{1,2}) + 0.5(u_{3,2})$

$= 0.5(0.0328) + 0.5(0.3152) = 0.174$

when $i=3$ $u_{3,3} = 0.5(u_{2,2}) + 0.5(u_{4,2})$

$= 0.5(0.1152) + 0.5(0.6088) = 0.362$