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Mtl no: 17/ENG06/1075

Course code: ENG,382

$U_t - CU_{xx} = 0$ for $0 \leq x \leq 1m$, $0 \leq t \leq 0.1 day$

Initial condition, $U(x,0) = x^4 K$, $0 \leq x \leq 1m$

$U(0,t) = 0K$, $U(1,t) = 1K$ for $0 \leq t \leq 0.1 day$

@ $x = 0m$, $x = 1m$ $\Delta x = 0.2m$, $\Delta t = 0.02 day$

$C = 1 \frac{m^3}{day}$

$U_t - CU_{xx} = 0$

$\therefore U_t - U_{xx} = 0$, $C = 1$

$\frac{dU}{dt} = \frac{d^2U}{dx^2} = 0$

Initial condition,

$U(x,0) = x^4 K$

@ $x = 0.2$, $U_{1,0} = (0.2)^4 = 1.6 \times 10^{-3} K$

@ $x = 0.4$, $U_{2,0} = (0.4)^4 = 0.0256 K$

@ $x = 0.6$, $U_{3,0} = (0.6)^4 = 0.1296 K$

@ $x = 0.8$, $U_{4,0} = (0.8)^4 = 0.4096 K$

From initial cond., $U_{0,0} = 0K$, $U_{5,0} = 1K$

$r = \frac{\Delta t}{(\Delta x)^2} = \frac{0.02}{(0.2)^2} = \frac{0.02}{0.04}$

$r = 1/2 = 0.5$

$1 - 2r = 1 - 2(0.5) = 1 - 1 = 0$

$\therefore (1 - 2r) = 0$

When $x = 1$, $t = 0$

$U_{1,1} = rU_{0,0} + (1-2r)U_{1,0} + rU_{2,0} = 0 + 0 + 0.5(0.0256) = 0.0128$

$U_{2,1}$ ($x=2$) $= rU_{1,0} + (1-2r)U_{2,0} + rU_{3,0} = 0.5(1.6 \times 10^{-3}) + 0 + 0.5(0.1296) = 0.0656$

$U_{3,1}$ ($x=3$) $= rU_{2,0} + (1-2r)U_{3,0} + rU_{4,0} = 0.5(0.0256) + 0 + 0.5(0.4096) = 0.2176$

$U_{4,1}$ ($x=4$) $= rU_{3,0} + (1-2r)U_{4,0} + rU_{5,0} = 0.5(0.1296) + 0 + 0.5(1) = 0.5648$

Now, $U_{0,1} = 0K$; $U_{5,1} = 1K$

When $x = 1$, $t = 0$

$U_{1,2} = rU_{0,1} + (1-2r)U_{1,1} + rU_{2,1} = 0.5(0) + 0 + 0.5(0.0656) = 0.0328 K$

$U_{2,2}$ ($x=2$) $= rU_{1,1} + (1-2r)U_{2,1} + rU_{3,1} = 0.5(0.0128) + 0 + 0.5(0.2176) = 0.1152 K$

$U_{3,2}$ ($x=3$) $= rU_{2,1} + (1-2r)U_{3,1} + rU_{4,1} = 0.5(0.0656) + 0 + 0.5(0.5648) = 0.3152 K$

$U_{4,2}$ ($x=4$) $= rU_{3,1} + (1-2r)U_{4,1} + rU_{5,1} = (0.5)(0.2176) + 0 + 0.5(1) = 0.6088 K$

$U_{0,2} = 0K$, $U_{5,2} = 1K$

$x=1, t=2$

$U_{1,3} = r U_{0,2} + (1-2r) U_{1,2} + r U_{2,2} = 0(0.5) + 0 + 0.5(0.1152) = 0.0576K$

$x=2$

$U_{2,3} = r U_{1,2} + (1-2r) U_{2,2} + r U_{3,2} = 0.5(0.0328) + 0 + 0.5(0.3152) = 0.174K$

$x=3$

$U_{3,3} = r U_{2,2} + (1-2r) U_{3,2} + r U_{4,2} = 0.5(0.1152) + 0 + 0.5(0.6088) = 0.362K$

$x=4$

$U_{4,3} = r U_{3,2} + (1-2r) U_{4,2} + r U_{5,2} = 0.5(0.3152) + 0 + 0.5(1) = 0.6576K$

$U_{0,3} = 0K, \; U_{5,3} = 1K$

$x=1, t=3$

$U_{1,4} = r U_{0,3} + (1-2r) U_{1,3} + r U_{2,3} = 0.5(0) + 0 + 0.5(0.174) = 0.087K$

$x=2$

$U_{2,4} = r U_{1,3} + (1-2r) U_{2,3} + r U_{3,3} = 0.5(0.0576) + 0 + 0.5(0.362) = 0.2098K$

$x=3$

$U_{3,4} = r U_{2,3} + (1-2r) U_{3,3} + r U_{4,3} = 0.5(0.174) + 0 + 0.5(0.6576) = 0.4158K$

$x=4$

$U_{4,4} = r U_{3,3} + (1-2r) U_{4,3} + r U_{5,3} = 0.5(0.362) + 0 + 0.5(1) = 0.681K$

$U_{0,4} = 0K, \; U_{5,4} = 1K$

$x=1, t=4$

$U_{1,5} = r U_{0,4} + (1-2r) U_{1,4} + r U_{2,4} = 0.5(0) + 0 + 0.5(0.2098) = 0.1049K$

$x=2$

$U_{2,5} = r U_{1,4} + (1-2r) U_{2,4} + r U_{3,4} = 0.5(0.087) + 0 + 0.5(0.4158) = 0.2514K$

$x=3$

$U_{3,5} = r U_{2,4} + (1-2r) U_{3,4} + r U_{4,4} = 0.5(0.2098) + 0 + 0.5(0.681) = 0.4454K$

$x=4$

$U_{4,5} = r U_{3,4} + (1-2r) U_{4,4} + r U_{5,4} = 0.5(0.4158) + 0 + 0.5(1) = 0.7079K$

$U_{0,5} = 0K, \; U_{5,5} = 1K$

$\Delta t(K)$

Step No	Grid No	0	1	2	3	4	5		
10	0	0	0.1049	0.2514	0.4454	0.7079	1	0	
0.08	1	0	0.087	0.2098	0.4158	0.681	1	1	
0.06	2	0	0.0576	0.174	0.362	0.6576	1	2	
0.04	3	0	0.0328	0.1152	0.3152	0.6088	1	3	
0.02	4	0	0.0128	0.0656	0.2176	0.5648	1	4	
0	5	0	0.0016	0.028	0.1296	0.4096	1	5	
		0	1	2	3	4	5		
		0	0.2	0.4	0.6	0.8	1.0		

$\Delta x(m)$

T(K)							0.5
0.1	0	0.1049	0.2514	0.4454	0.7079	1	Name:SHOKUNBI EMMANUEL
0.08	0	0.087	0.2098	0.4158	0.681	1	Mat no:17ENG06075
0.06	0	0.0576	0.174	0.362	0.6576	1	
0.04	0	0.0328	0.1152	0.3152	0.6088	1	
0.02	0	0.0128	0.0656	0.2176	0.5648	1	For 0=<x=<1;change in x =0.2
0	0	0.0016	0.0256	0.1296	0.4096	1	For 0=<t=<0.1;change in t = 0.02
	0	0.2	0.4	0.6	0.8	1 X(m)