**fldfkllAssignment 10**

1. Note that above scheme is a subset of the theta-method given in the mid sem. Assume that you are solving for the diffusion equation in the domain t>0, 0<x<1 with the following initial and boundary conditions

f(x,0) = sin (πx), f(0,t) = 0 = f(1,t). Show that the analytical solution is

f(x,t) = exp(-2 απt) sin(πx) (This you can show by mere substitution).

2. Solve it by explicit method with Take the value of alpha = 0.01. and delx = 0.1. Choose delt such that Diffusion number is 0.5. Plot the results for the numerical and analytical at t = 10 and t = 20. 3. Repeat the same at D = 1/6 and plot the results at t = 10 and t = 20.

4. Re-run this case for D = 2.0 and plot the results. In this case carry the calculations till t=40 plot the results at t = 10, 20 and 40.

5. Write a computer code to solve the diffusion equation using the Theta method. Do as directed. Carry all calculations upto t = 40 or just close to it.

(i) Solve for theta = 1.0, with D = 2.0 and Comment on the results by plotting the data at t = 10, and 40.

(ii) Solve for theta = 0.5, theta = 1. with D= 2.0. Comment on the results by plotting the data at t = 10, and 40.

(iii) Solve for theta = 0.5-(1/12D). with D= 2.0. Comment on the results by plotting the data at t = 10, and 40.

(iv) Solve for theta = 0.5,-1/(12D). with D= 1/sqrt(20). Comment on the results by plotting the data at t = 10, and 40.

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Typical Coding

Tin = 0.

Tmax = 42.

Dee =5

Theta = 0.5

Tright=0.

Tleft=0.

Alpha=0.01

el=1.

Nodes=11

delx=El/Float(Nodes-1)

delt=Dee\*delx\*delx/alpha

C Grid Generation

x(1)=0.

DO I=2,Nodes

x(I)=x(I-1)+ delx

End Do

C \*\*\*\*\*\* TEMPERATURE INITIALIZATION \*\*\*

pi=4.\*Atan(1.)

DO I=1,Nodes+2

T0(I)=sin(pi\*x(I))

End Do

tt=Tin+delt

C \*\*\*\*\*\* COMPUTATION of TRIDIAGONAL COEFFICIENTS FOR INT. NODES \*\*\*\* 10 DO 50 I=2,Nodes-1

AA(I,1)=-Theta\*dee

AA(I,3)=AA(I,1)

AA(I,2)=1.-AA(I,1)-AA(I,3)

50 C(I)=(1.-Theta)\*dee\*T0(i+1)+(1.-2\*(1-Theta)\*Dee)\*T0(i)+ 1 (1.-Theta)\*dee\*T0(i-1)

C \*\*\*\*\*\*TREATMENT OF BOUNDARY NODES \*\*\*\*\* AA(1,2)=1.

AA(1,3)=0.

C(1)=0.

AA(Nodes,1)=0.

AA(Nodes,2)=1.

C(Nodes)=0.

C \*\*\*

C \*\*\*\*\*\*COMPUTATION OF TEMPERATURES \*\*\*\* CALL THOMAS(Nodes,AA,C,T)

C\*\*Computation of Analytical Solution

write(13,\*)tt

Do 100 I = 1,Nodes

T\_ana(i)=exp(-alpha\*pi\*pi\*tt)\*sin(pi\*x(i))

write(13,\*)x(i),T(I),T\_ana(I)

100 EndDo

C \*\*\*\*\*\* Update, Continue/Terminate

tt=tt+delt

If(tt.gt.Tmax) Then

Stop

Else

Do I = 1,Nodes

T0(i)=T(i)

End Do

Goto 10

Endif

C \*\*\*\*\*\*

END