(ME 543)
COMPUTATIONAL FLUID DYNAMICS

Assignment - *2*

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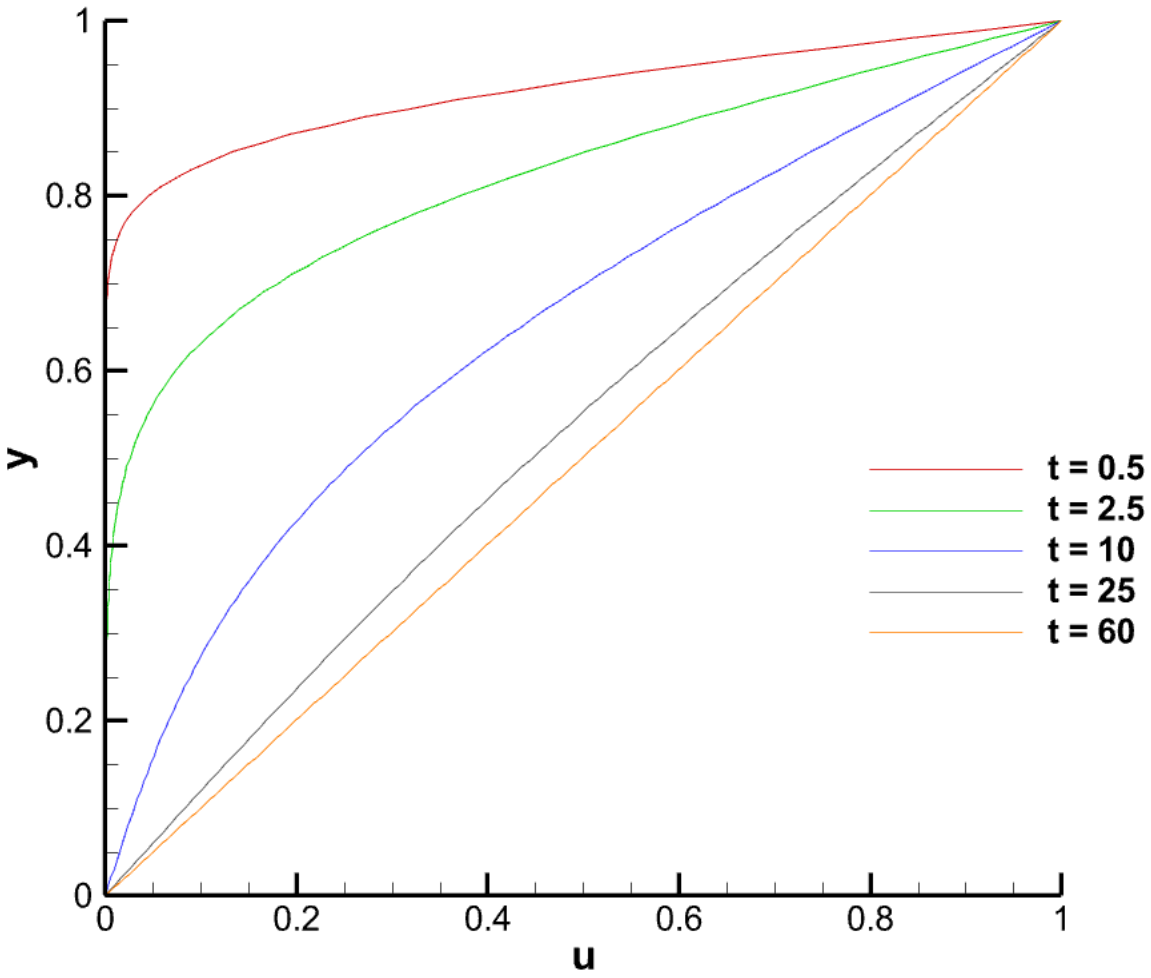
COMPUTATIONAL MECHANICS

Problem - *1*

1. Explicit method : **FTCS**

$$\phi_i^{n+1} = \gamma_x \phi_{i+1}^n + (1 - 2\gamma_x)\phi_i^n + \gamma_x \phi_{i-1}^n$$



- Number of time iterations to converge up to ϵ <10-6 = ***11641***
- Physical time taken to converge up to ϵ <10-6 = ***58.205***

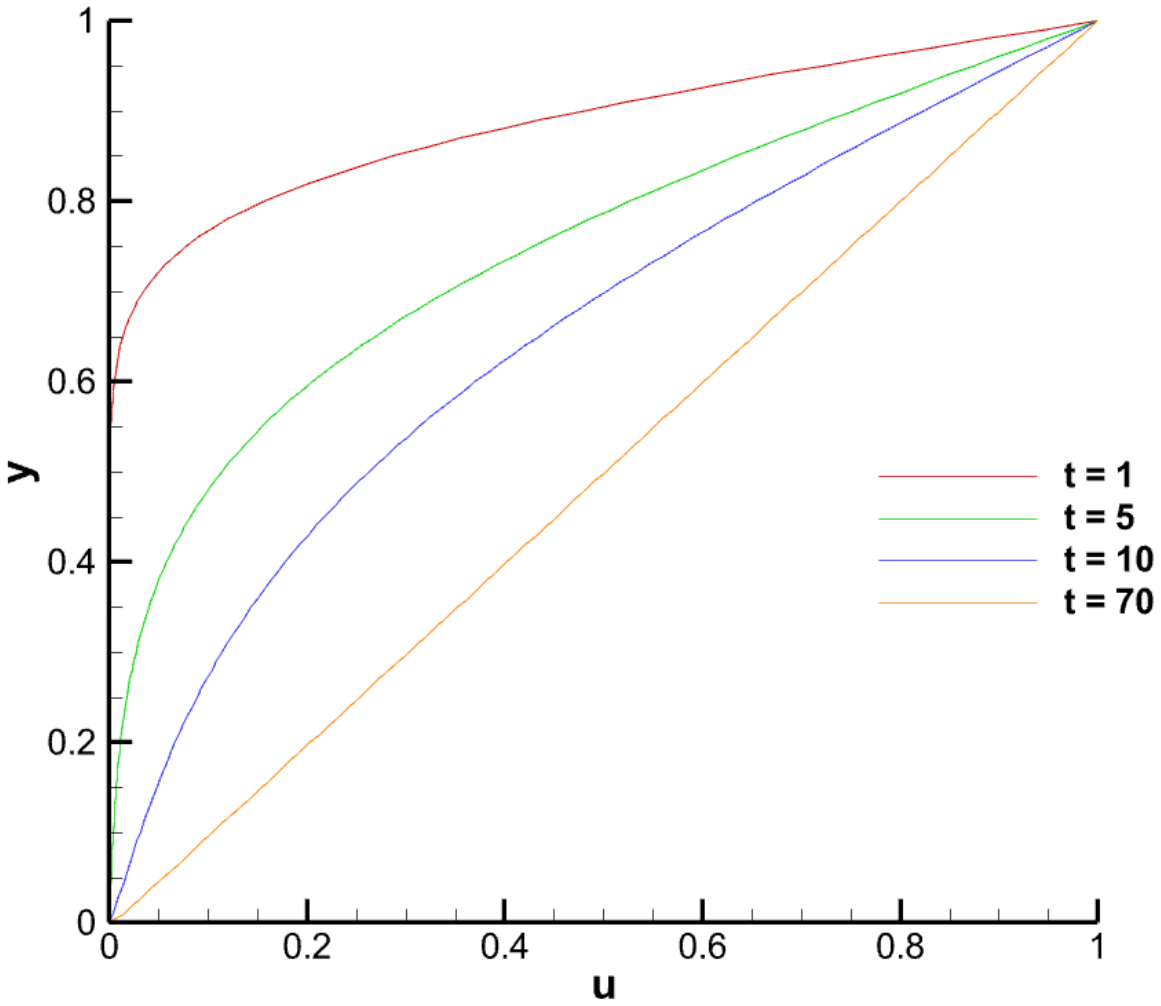
Time (t)	No. of iterations
0.5	100
2.5	500
10	2000
25	5000
60	12000

Problem - *2*

2. Implicit method : **BTCS**

Line Gauss-Seidel iterative method (***TriDiagonal Matrix Algorithm***)

$$\gamma_x \phi_{i-1}^{n+1} - (1 + 2\gamma_x)\phi_i^{n+1} + \gamma_x \phi_{i+1}^{n+1} = -\phi_i^n$$



- Number of time iterations to converge up to ϵ <10-6 = ***6230***
- Physical time taken to converge up to ϵ <10-6 = ***62.29***

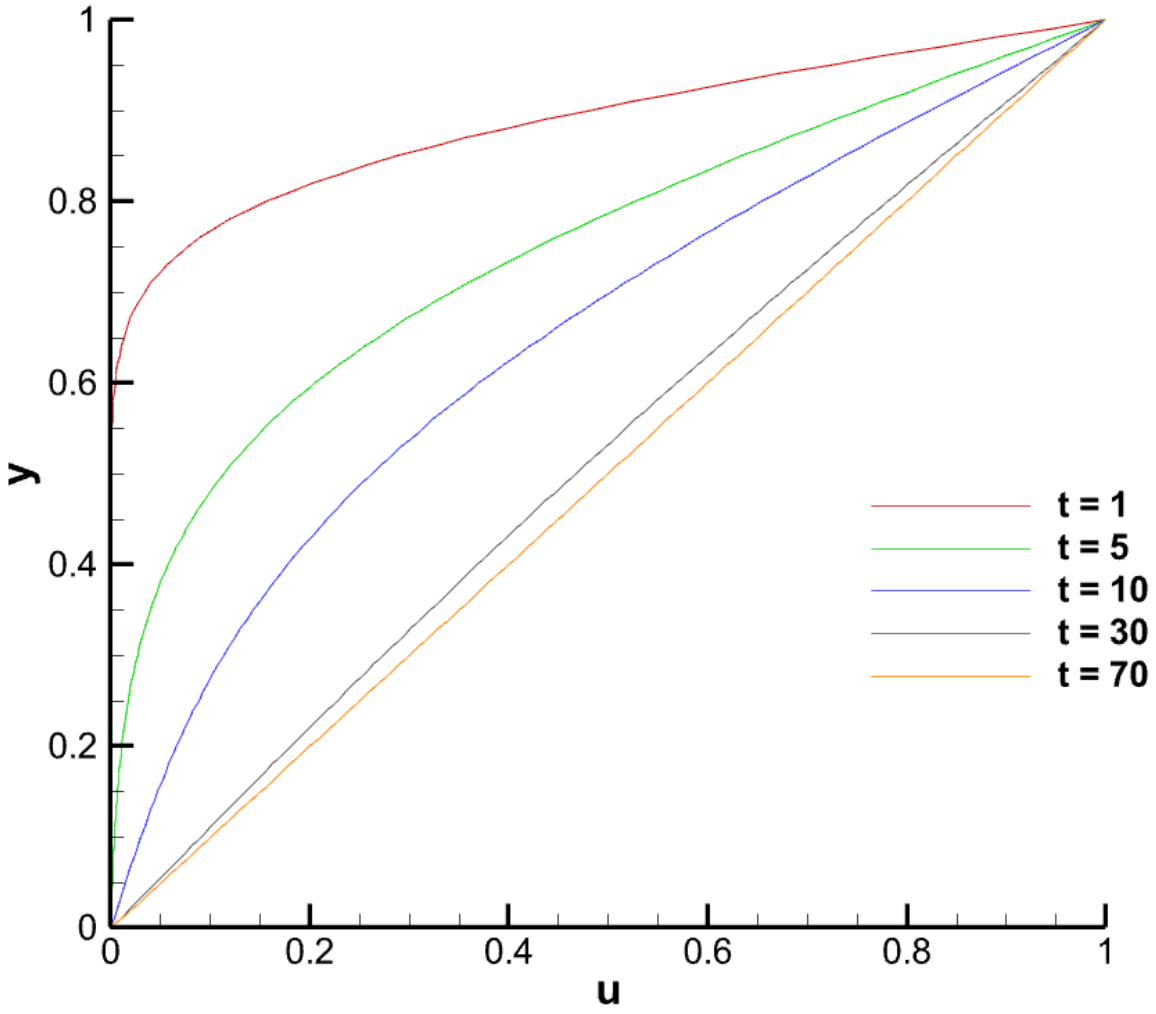
Time (t)	No. of iterations
1	100
5	500
10	1000
70	7000

Problem - *2*

2. Implicit method : **Crank-Nicolson**

Line Gauss-Seidel iterative method (***TriDiagonal Matrix Algorithm***)

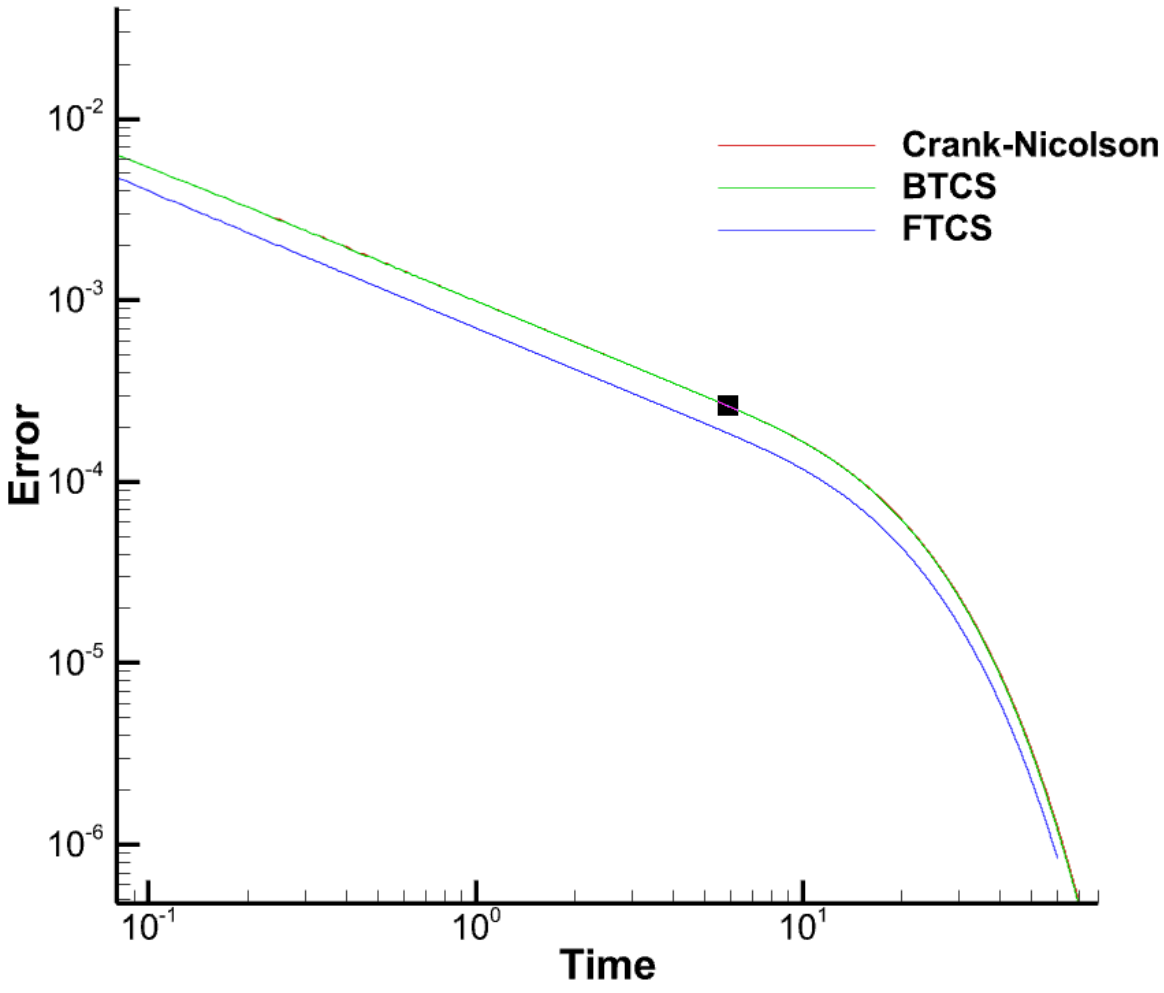
$$\frac{\phi_i^{n+1} - \phi_i^n}{\Delta t} = \frac{\Gamma}{2}\left[\frac{\phi_{i+1}^{n+1} - 2\phi_i^{n+1} + \phi_{i-1}^{n+1}}{(\Delta x)^2} + \frac{\phi_{i+1}^{n} - 2\phi_i^{n} + \phi_{i-1}^{n}}{(\Delta x)^2}\right]$$



- Number of time iterations to converge up to ϵ <10-6 = ***6189***
- Physical time taken to converge up to ϵ <10-6 = ***61.88***

Time (t)	No. of iterations
1	100
5	500
10	1000
70	7000

Error Vs Time



Error vs Time plot on log-log scale