INTRODUCTION TO THE SOLUTION OF FINITE DIFFERENCE EQUATIONS

- Solve the unsteady heat conduction/diffusion equation

$$\frac{\partial T}{\partial t} = \alpha \frac{\partial^2 T}{\partial x^2}$$

with the following initial and boundary conditions:

$$T(0,t) = 20, \quad T(10,t) = 100 \quad T(x,0) = 10$$

Use the incomplete Fortran code *fd.f* Take $imax = 201$ and experiment with the diffusion number, $d = \alpha \Delta t / \Delta x^2$. Obtain and compare the solutions with
a) the explicit Forward Time-Backard/Central/Forward Space FDEs
b) the implicit Backward Time-Central Space FDE
c) the boundary condition at $x = 0$ as an insulated wall.

- Solve the linear convection equation

$$\frac{\partial w}{\partial t} + V \frac{\partial w}{\partial x} = 0$$

with the following initial and boundary conditions:

$$w(x,0) = 10\cos(x) \text{ for } 0 \leq x \leq \pi, \qquad w(x,0) = 0 \text{ for } x < 0 \text{ and } x > \pi$$

$$w(-10,t) = 0, \quad \frac{\partial w}{\partial x}|_{(20,t)} = 0$$

Take $\Delta x = 0.1$ and experiment with the Courant number, $\sigma = V \Delta t / \Delta x$. Obtain and compare the solutions with
a) the explicit FTCS and FTBS FDEs
b) the implicit BTCS FDE

- For a bonus, solve the 1-D convection-diffusion equation explicitly and implicitly.