1D Time-Dependent Problems (Galerkin method)

PDEs:

$$
\begin{aligned}
C_{11}\frac{\partial U1}{\partial t} + ... + C_{1N}\frac{\partial UN}{\partial t} &= \frac{\partial A_1}{\partial x}(x,t,U1,U1_x,...,UN,UN_x) \\
&- F_1(x,t,U1,U1_x,...,UN,UN_x) \\
&= \\
&= \\
C_{N1}\frac{\partial U1}{\partial t} + ... + C_{NN}\frac{\partial UN}{\partial t} &= \frac{\partial A_N}{\partial x}(x,t,U1,U1_x,...,UN,UN_x) \\
&- F_N(x,t,U1,U1_x,...,UN,UN_x)
\end{aligned}
$$

where the C_{ij} are functions of $(x,t,U1,...,UN)$.

Boundary conditions (at endpoints):

$$
\begin{aligned}
U1 &= FB_1(t) \\
&= \\
&= \\
UN &= FB_N(t)
\end{aligned}
$$

or

$$
\begin{aligned}
\pm A_1 &= GB_1(t,U1,U1_x,...,UN,UN_x) \\
&= \\
&= \\
\pm A_N &= GB_N(t,U1,U1_x,...,UN,UN_x)
\end{aligned}
$$

Initial conditions:

$$
\begin{aligned}
U1(x,t_0) &= U1_0(x) \\
&= \\
&= \\
UN(x,t_0) &= UN_0(x)
\end{aligned}
$$