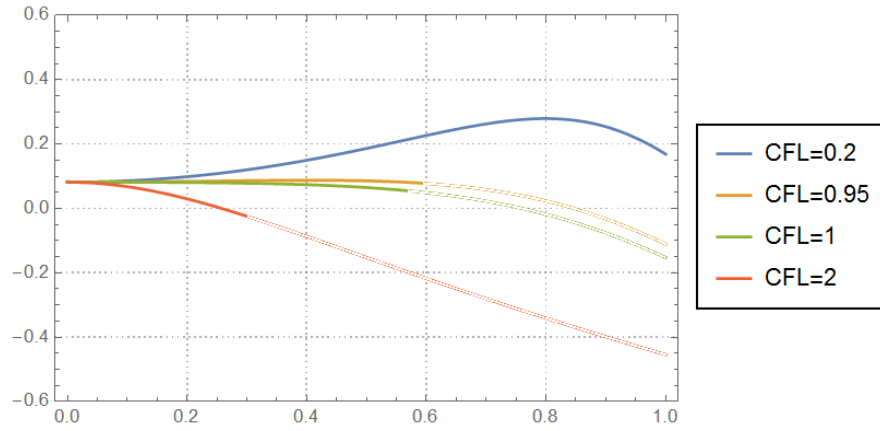
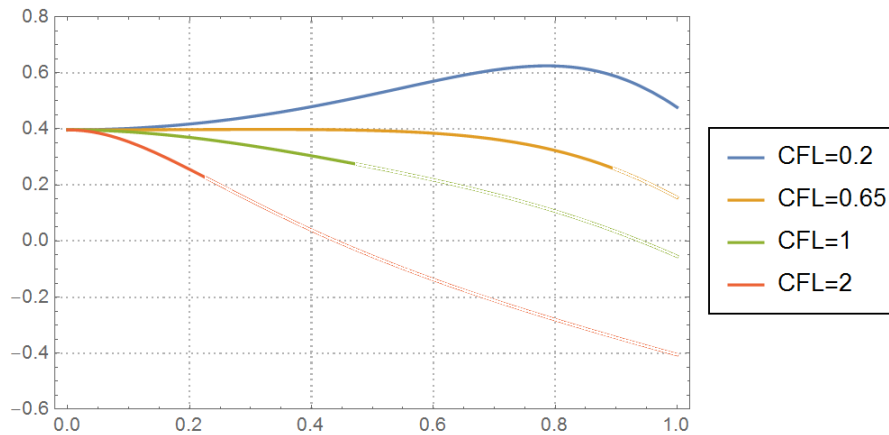


### Solution 1 b) Numerical Dispersion Curves

For  $\beta_1 = 0.39$ :



For  $\beta_1 = 0.65$ :



**Solution 1 c)** Values of  $k\Delta x$  corresponding to  $\frac{\Delta t}{T} \geq 0.3$

$\left(\frac{k\Delta x}{\pi}, \frac{c-c_0}{c_0}\right)$  corresponding to  $\frac{\Delta t}{T} \geq 0.3$  have been presented in the above plots as dulated curves.

**Solution 1 d)** Optimal CFL values

In case of  $\beta_1 = 0.39$ , wave modes for  $k\Delta x < 1$  have  $\frac{c-c_0}{c_0}$  value of about 0.08 and the optimal CFL value is 0.95. Since the shortest wavelength is  $2\Delta x$ , wave nodes with  $k\Delta x > 1$  do exist. There is no CFL number for which all modes are non-dispersive. In case of  $\beta_1 = 0.65$ , the  $\frac{c-c_0}{c_0}$  value is 0.40 and the optimal CFL value is 0.65. The discarded wave modes (i.e. the ones corresponding to  $\frac{\Delta t}{T} \geq 0.3$ ) have been presented above as dulated curves.