Prob. 19.11- Load-unload stress cycle

Define step function $u(t)$ using Heaviside function:

\[
> u := \text{proc}(t, a) \ \text{Heaviside}(t - a) \ \text{end};
\]

Define stress history:

\[
> \sigma := (t) \rightarrow 1 \cdot u(t, 1) - 2 \cdot u(t, 4.5) + 1 \cdot u(t, 5);
\]

\[
> \text{plot}(\sigma(t), t = -1..7);
\]

Define SLS creep compliance:

\[
> C_{\text{crp}} := (t) \rightarrow C_g + (C_r - C_g) \cdot (1 - \exp(-t/\tau));
\]

\[
C_{\text{crp}} := t \rightarrow C_g + (C_r - C_g) \left(1 - e^{-\left(\frac{t}{\tau}\right)}\right)
\]

Examine compliance function with given parameters:

\[
> C_g := 5; C_r := 10; \tau := 2;
\]

\[
> \text{plot}(C_{\text{crp}}(t), t = 0..10);
\]

Superposition integral for strain history:
Note that for this particular case the strain after $t=5$ rises above zero even though all the stress has been removed - a consequence of the material's memory of the long tensile stress preceding the short compressive stress.