In[ ]:=
```
LaplaceTransform [
  D[F[t], t] + F / (R * Ce) == (1 / Ce + 1 / Cp) * D[S[t], t] + 1 / (R * Ce * Cp) * S + F0[t] / (R * Ce), t, s]
```

Out[ ]=
$$\frac{F}{Ce\ R\ s} - F[0] + s\ \text{LaplaceTransform}[F[t], t, s] == \frac{S}{Ce\ Cp\ R\ s} + \frac{\text{LaplaceTransform}[F0[t], t, s]}{Ce\ R} + \left(\frac{1}{Ce} + \frac{1}{Cp}\right)(s\ \text{LaplaceTransform}[S[t], t, s] - S[0])$$

In[ ]:=
$$\text{Solve}\left[\frac{F}{Ce\ R\ s} - F[0] + s\ \text{LaplaceTransform}[F[t], t, s] == \frac{S}{Ce\ Cp\ R\ s} + \frac{\text{LaplaceTransform}[F0[t], t, s]}{Ce\ R} + \left(\frac{1}{Ce} + \frac{1}{Cp}\right)(s\ \text{LaplaceTransform}[S[t], t, s] - S[0]), S\right]$$

Out[ ]=
$$\{\{S \to Cp\ F - Ce\ Cp\ R\ s\ F[0] + Ce\ Cp\ R\ s^2\ \text{LaplaceTransform}[F[t], t, s] - Cp\ s\ \text{LaplaceTransform}[F0[t], t, s] - Ce\ R\ s^2\ \text{LaplaceTransform}[S[t], t, s] - Cp\ R\ s^2\ \text{LaplaceTransform}[S[t], t, s] + Ce\ R\ s\ S[0] + Cp\ R\ s\ S[0]\}\}$$

In[ ]:=
$$S\ /.\ \{\{S \to Cp\ F - Ce\ Cp\ R\ s\ F[0] + Ce\ Cp\ R\ s^2\ \text{LaplaceTransform}[F[t], t, s] - Cp\ s\ \text{LaplaceTransform}[F0[t], t, s] - Ce\ R\ s^2\ \text{LaplaceTransform}[S[t], t, s] - Cp\ R\ s^2\ \text{LaplaceTransform}[S[t], t, s] + Ce\ R\ s\ S[0] + Cp\ R\ s\ S[0]\}\}$$

Out[ ]=
$$\{Cp\ F - Ce\ Cp\ R\ s\ F[0] + Ce\ Cp\ R\ s^2\ \text{LaplaceTransform}[F[t], t, s] - Cp\ s\ \text{LaplaceTransform}[F0[t], t, s] - Ce\ R\ s^2\ \text{LaplaceTransform}[S[t], t, s] - Cp\ R\ s^2\ \text{LaplaceTransform}[S[t], t, s] + Ce\ R\ s\ S[0] + Cp\ R\ s\ S[0]\}$$

In[ ]:=
$$\text{First}[\{Cp\ F - Ce\ Cp\ R\ s\ F[0] + Ce\ Cp\ R\ s^2\ \text{LaplaceTransform}[F[t], t, s] - Cp\ s\ \text{LaplaceTransform}[F0[t], t, s] - Ce\ R\ s^2\ \text{LaplaceTransform}[S[t], t, s] - Cp\ R\ s^2\ \text{LaplaceTransform}[S[t], t, s] + Ce\ R\ s\ S[0] + Cp\ R\ s\ S[0]\}]$$

Out[ ]=
$$Cp\ F - Ce\ Cp\ R\ s\ F[0] + Ce\ Cp\ R\ s^2\ \text{LaplaceTransform}[F[t], t, s] - Cp\ s\ \text{LaplaceTransform}[F0[t], t, s] - Ce\ R\ s^2\ \text{LaplaceTransform}[S[t], t, s] - Cp\ R\ s^2\ \text{LaplaceTransform}[S[t], t, s] + Ce\ R\ s\ S[0] + Cp\ R\ s\ S[0]$$

In[ ]:=
```
Solve[D[F[t], t] + F[t] / (R * Ce) ==
  (1 / Ce + 1 / Cp) * D[S[t], t] + 1 / (R * Ce * Cp) * S + F0[t] / (R * Ce), D[S[t], t]]
```

Out[ ]=
$$\left\{\left\{S'[t] \to \frac{-S + Cp\ F[t] - Cp\ F0[t] + Ce\ Cp\ R\ F'[t]}{(Ce + Cp)\ R}\right\}\right\}$$

In[ ]:=
$$S'[t]\ /.\ \left\{\left\{S'[t] \to \frac{-S + Cp\ F[t] - Cp\ F0[t] + Ce\ Cp\ R\ F'[t]}{(Ce + Cp)\ R}\right\}\right\}$$

Out[ ]=
$$\left\{\frac{-S + Cp\ F[t] - Cp\ F0[t] + Ce\ Cp\ R\ F'[t]}{(Ce + Cp)\ R}\right\}$$

S

In[ ]:= DSolve[
D[F[t], t] + F[t] / (R * Ce) == (1 / Ce + 1 / Cp) * D[S[t], t] + 1 / (R * Ce * Cp) * S[t] + F0[t] / (R * Ce), S[t], t]

Out[ ]= $$\left\{\left\{S[t] \to e^{-\frac{t}{(Ce+Cp) R}} c_1 + e^{-\frac{t}{(Ce+Cp) R}} \int_1^t \frac{e^{\frac{K[1]}{(Ce+Cp) R}} (Cp\, F[K[1]] - Cp\, F0[K[1]] + Ce\, Cp\, R\, F'[K[1]])}{(Ce + Cp) R} \, dK[1]\right\}\right\}$$

In[ ]:= $$S[t\_] := e^{-\frac{t}{(Ce+Cp) R}} c_1 + e^{-\frac{t}{(Ce+Cp) R}} \int_1^t \frac{e^{\frac{K[1]}{(Ce+Cp) R}} (Cp\, F[K[1]] - Cp\, F0[K[1]] + Ce\, Cp\, R\, F'[K[1]])}{(Ce + Cp) R} \, dK[1]$$

In[ ]:= $$\left\{\left\{S[t] \to e^{-\frac{t}{(Ce+Cp) R}} c_1 + e^{-\frac{t}{(Ce+Cp) R}} \int_1^t \frac{e^{\frac{K[1]}{(Ce+Cp) R}} (Cp\, F[K[1]] - Cp\, F0[K[1]] + Ce\, Cp\, R\, F'[K[1]])}{(Ce + Cp) R} \, dK[1]\right\}\right\}[[1, 1, 2]]$$

Out[ ]= $$e^{-\frac{t}{(Ce+Cp) R}} c_1 + e^{-\frac{t}{(Ce+Cp) R}} \int_1^t \frac{e^{\frac{K[1]}{(Ce+Cp) R}} (Cp\, F[K[1]] - Cp\, F0[K[1]] + Ce\, Cp\, R\, F'[K[1]])}{(Ce + Cp) R} \, dK[1]$$

In[ ]:= $$\text{Activate}\left[e^{-\frac{t}{(Ce+Cp) R}} c_1 + e^{-\frac{t}{(Ce+Cp) R}} \int_1^t \frac{e^{\frac{K[1]}{(Ce+Cp) R}} (Cp\, F[K[1]] - Cp\, F0[K[1]] + Ce\, Cp\, R\, F'[K[1]])}{(Ce + Cp) R} \, dK[1],\right.$$
$$\left.\text{Unevaluated[Integrate]}\right]$$

Out[ ]= $$e^{-\frac{t}{(Ce+Cp) R}} c_1 + e^{-\frac{t}{(Ce+Cp) R}} \int_1^t \frac{e^{\frac{K[1]}{(Ce+Cp) R}} (Cp\, F[K[1]] - Cp\, F0[K[1]] + Ce\, Cp\, R\, F'[K[1]])}{(Ce + Cp) R} \, dK[1]$$

In[ ]:= $$\text{Simplify}\left[e^{-\frac{t}{(Ce+Cp) R}} c_1 + e^{-\frac{t}{(Ce+Cp) R}} \int_1^t \frac{e^{\frac{K[1]}{(Ce+Cp) R}} (Cp\, F[K[1]] - Cp\, F0[K[1]] + Ce\, Cp\, R\, F'[K[1]])}{(Ce + Cp) R} \, dK[1]\right]$$

Out[ ]= $$e^{-\frac{t}{(Ce+Cp) R}} \left(c_1 + \int_1^t \frac{Cp\, e^{\frac{K[1]}{(Ce+Cp) R}} (F[K[1]] - F0[K[1]] + Ce\, R\, F'[K[1]])}{(Ce + Cp) R} \, dK[1]\right)$$