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(*Use the method of Laplace transform for solving the following differential equation*)

(*1*)
deq = y''[t] + 2 y'[t] + 2 y[t] == DiracDelta[t - Pi];
initial = {y[0] → 1, y'[0] → 0};
aeq = LaplaceTransform[deq, t, s] /. initial
fs = Solve[aeq, LaplaceTransform[y[t], t, s]]
fs = LaplaceTransform[y[t], t, s] /. fs[[1]] /. w → 1
yt = InverseLaplaceTransform[fs, s, t]
Plot[yt, {t, 0, 10}]

? Heavisidetheta
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HeavisideTheta[x] represents the Heaviside theta function $\theta(x)$, equal to 0 for $x < 0$ and 1 for $x > 0$.
HeavisideTheta[x_1, x_2, …] represents the
multidimensional Heaviside theta function which is 1 only if none of the x_i are not positive. ≫

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(* 1st EQ *)

deq = y''[x] + y'[x] + y[x] Log[1 + x] == 0;
initial = {y[0] → 1, y'[0] → 0};
aeq = LaplaceTransform[deq, x, s] /. initial;
fs = Solve[aeq, LaplaceTransform[y[x], x, s]]
fs = LaplaceTransform[y[x], x, s] /. fs[[1]] /. w → 1
yt = InverseLaplaceTransform[fs, s, x]
Plot[yt, {x, 0, 10}]

(* 2nd EQ *)

deq = y''[x] + y'[x] + Log[1 + x] y[x] == 0;
initial = {y[0] == 1, y'[0] == 0}; s = 10;
ser = y[x] + O[x]^s;
sereq = deq /. {y[x] -> ser, y'[x] → D[ser, x], y''[x] → D[ser, {x, 2}]};
(*Make the list of equations*)
eqs = Join[{sereq}, initial];
unknowns = Table[Derivative[n][y][0], {n, 0, s - 1}];
knowns = Solve[eqs, unknowns];
ser = ser /. knowns[[1]];
"Series approximation"
sersol = Normal[ser];
(*Exact solution*)
(*sol1=DSolve[{deq,y[0]==1,y'[0]==0},y[x],x];
"Exact solution"
  exsol=y[x]/.sol1[[1]]*)
"Comapare exact solution and series approximation"
Plot[sersol, {x, 0, 10}, PlotStyle → {{Black, Thick, Dotted}}]
```