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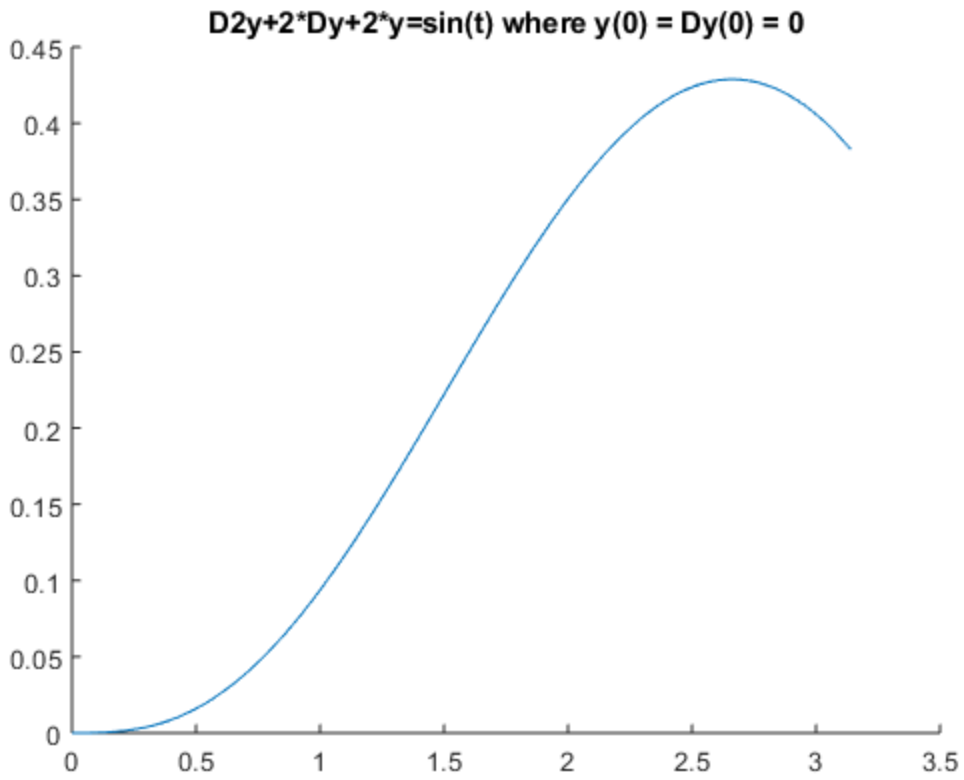
```
% Some Laplace transforms
```

QUESTION 1

12 (a)

```
syms t y
hold on
sol = dsolve('D2y = -2*Dy-2*y+sin(t)', 'y(0)=0', 'Dy(0)=0', 't')
fplot(sol, [0, pi])
title ('D2y+2*Dy+2*y=sin(t) where y(0) = Dy(0) = 0')
```

```
sol =

(2*exp(-t)*cos(t))/5 + (exp(-t)*sin(t))/5 - sin(t)*(cos(2*t)/5 -
 sin(2*t)/10) + exp(-t)*cos(t)*((cos(2*t)*exp(t))/10 - exp(t)/2 +
 (sin(2*t)*exp(t))/5)
```

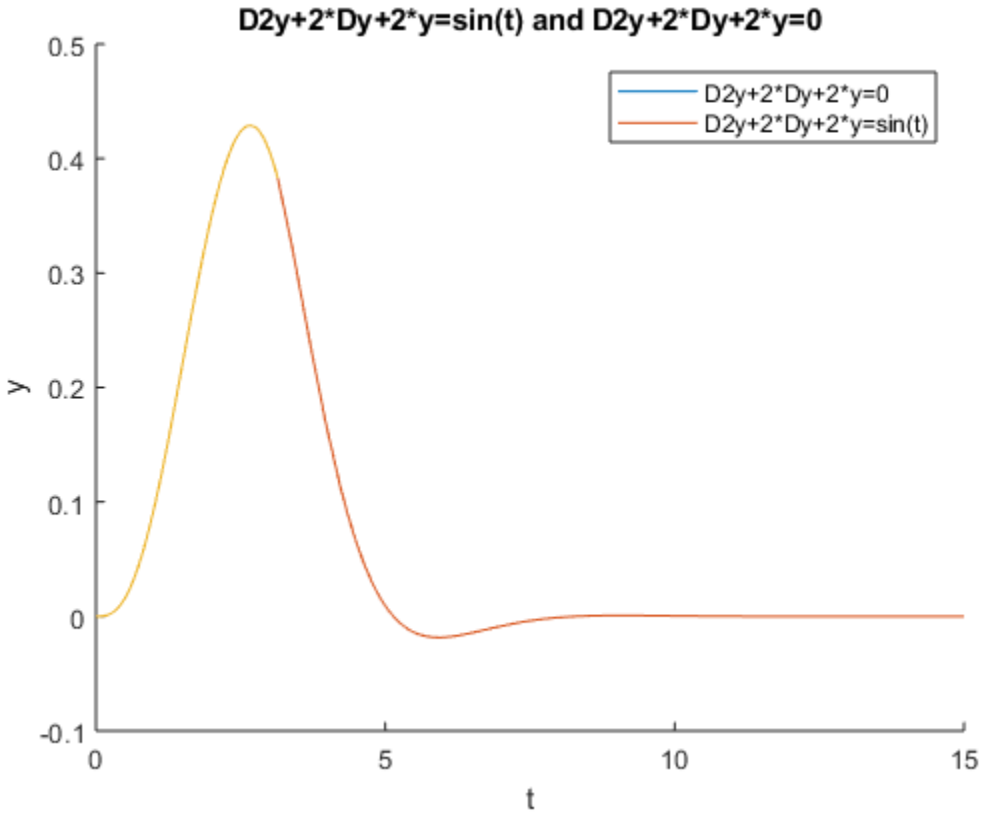


12 (b)

```
i1 = subs(sol,pi)
i2 = subs(diff(sol),pi)
sol2= dsolve('D2y+2*Dy+2*y=0','y(pi)=2/5-(2*exp(-pi))/5','Dy(pi)=-
exp(-pi)/5-1/5')
hold on
fplot(sol2,[pi 15])
fplot(sol, [0, pi])
axis([0 15 -.1 .5])
title('D2y+2*Dy+2*y=sin(t) and D2y+2*Dy+2*y=0')
xlabel 't'; ylabel 'y';
hold off
legend ('D2y+2*Dy+2*y=0','D2y+2*Dy+2*y=sin(t)')
```

```
i1 =

2/5 - (2*exp(-pi))/5


i2 =

exp(-pi)/5 - 1/5
```

```
sol2 =

- exp(-t)*cos(t)*((2*exp(pi))/5 - 2/5) - exp(-t)*sin(t)*(exp(pi)/5 -
 3/5)
```



12 (c)

```
syms t s Y;
f = ['heaviside(t)*sin(t)+heaviside(t-pi)*(-sin(t))'];
eqn = sym(['D(D(y))(t)+2*D(y)(t)+2*y(t)=' f]);
lteqn = laplace(eqn, t ,s);
neweqn = subs(lteqn, {'laplace(y(t),t,s)','y(0)',subs(diff(y,t),t,0)},
{Y,0,0});
ytrans = solve(neweqn, Y);
y = ilaplace(ytrans, s, t)

% (c) contd..
y = ilaplace(ytrans, s, t);
sol = dsolve('D2y = -2*Dy-2*y+sin(t)', 'y(0)=0', 'Dy(0)=0', 't');
sol2= dsolve('D2y+2*Dy+2*y=0','y(pi)=0.3827','Dy(pi)=-0.1914');
fplot(y,[0 15])
hold on
fplot(sol,[0 pi])
hold on
fplot(sol2,[pi 15])
```

```
hold on
axis([0 15 -.1 0.5])
title('D2y+2*Dy+2*y as a Homogenous Eq and Nonhomogenous Eq')
xlabel 't'; ylabel 'y';
legend ('y','sol','sol2')
hold off
% the Laplace transform method gives the same solution and the same
 graph as from part b
% so Laplace gives the same result with less work than splitting the
 problem into two IVPs
```

```
Warning: Support of character vectors will be removed in a future
release. Character vectors can be used only for variable names and
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y =

sin(t)/5 - (2*cos(t))/5 + (2*exp(-t)*(cos(t) + sin(t)/2))/5 -
 heaviside(t - pi)*(sin(t)/5 - (2*cos(t))/5 + (2*exp(pi - t)*(cos(t) +
 sin(t)/2))/5) + exp(-t)*sin(t)*subs(diff(y(t), t), t, 0)

Warning: Finite sets ('DOM_SET') not supported. Using element 't = 0'
instead.
```
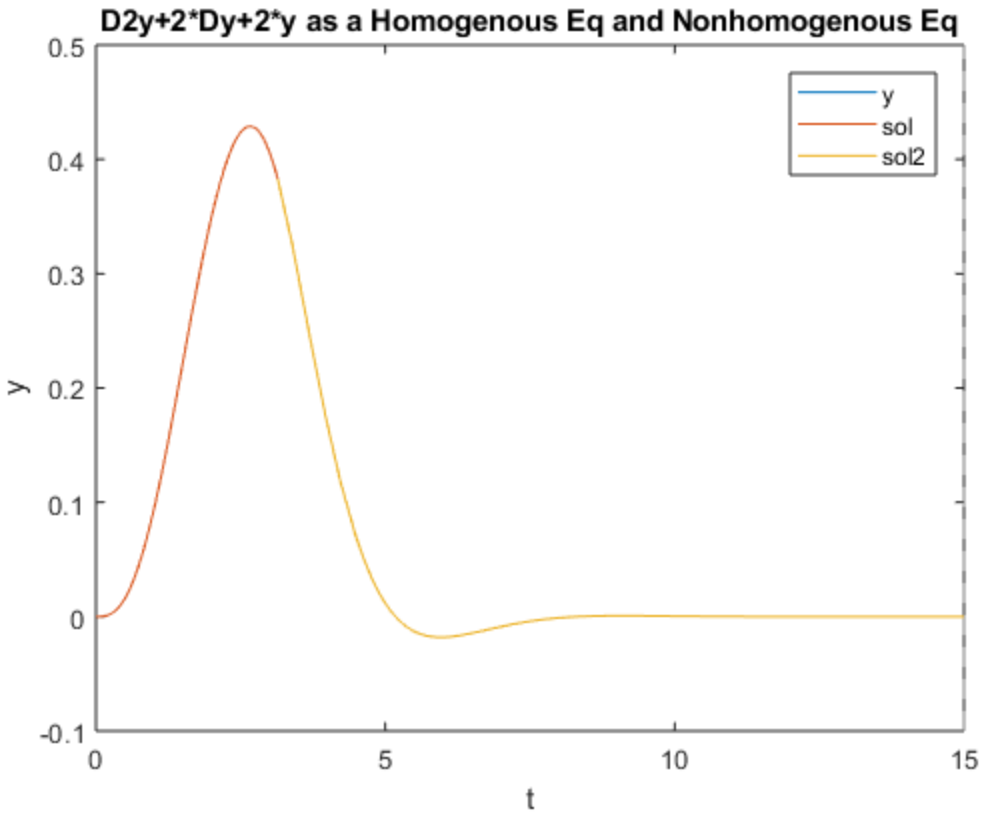



12 (d)

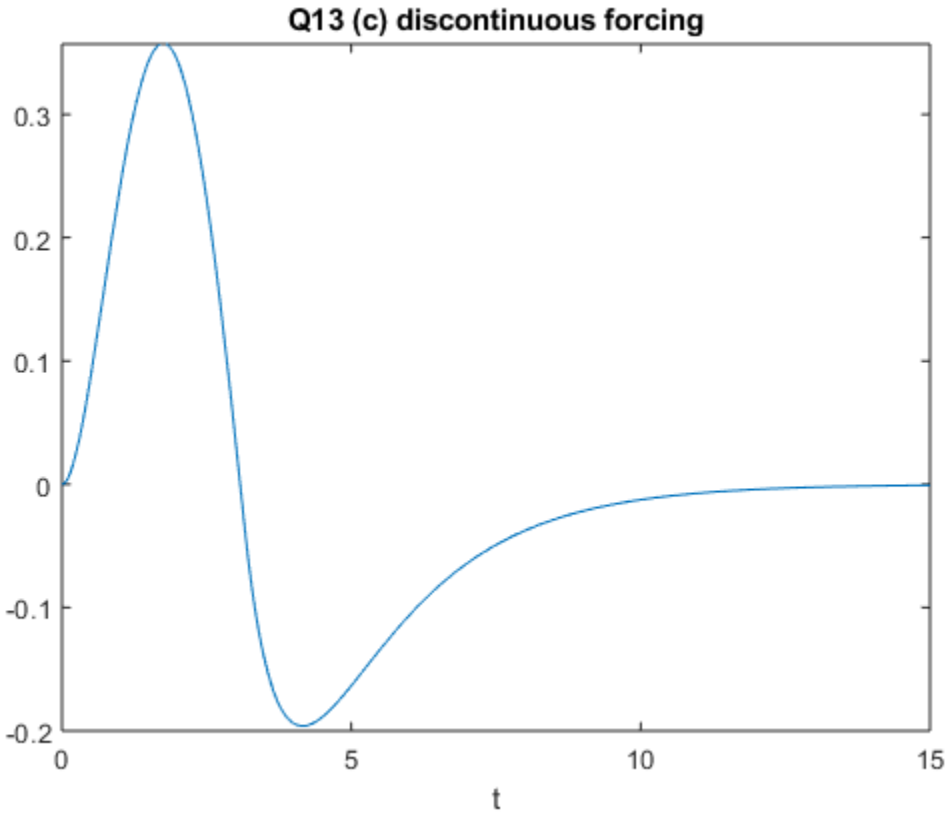
```
dsolve('D2y+2*Dy+2*y=0')
% As t approaches infinity, the behavior of solutions is that they
 approach 0.
% Since the characteristic roots are complex with negative real parts,
 the
% homogeneous equation will decay to zero in an oscillatory manner.
% The inhomogeneous equation will remain at 0 for its longterm
 behavior.


ans =

C12*exp(-t)*cos(t) + C13*exp(-t)*sin(t)
```

QUESTION 2

13 (c)

```
syms s t Y;
g= cos(t)+ (0-cos(t))*heaviside(t-pi);
G=laplace(g,t,s);
Y1=s*Y-0;
```

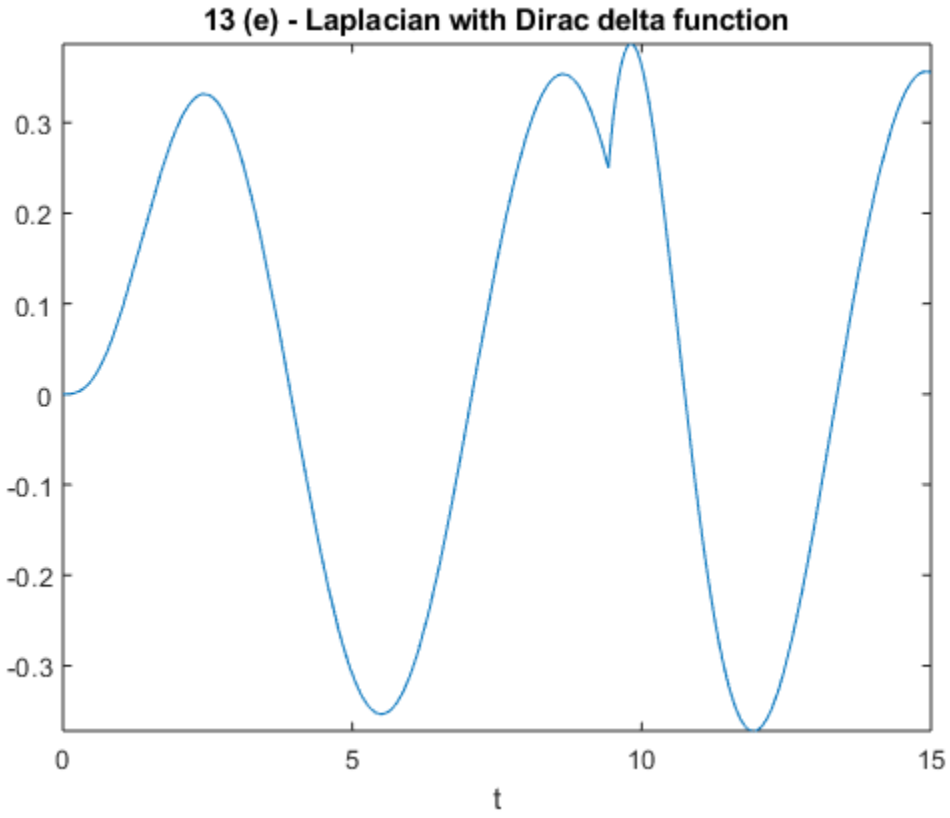
```
Y2=s*Y1-0;
EQN=solve(Y2+2*Y1+(4/5)*Y-G,Y);
sol=ilaplace(EQN,s,t);
fplot(sol,[0,15]); xlabel('t')
title('Q13 (c) discontinuous forcing');
% Due to the forcing, the solutions are switched on and off at a given
 particular time.
% Between 0 to pi, the solution looks like a cosine function. After t
 > pi,
% the solution is forced to zero.
```



13 (e)

```
figure;
syms s t Y
f= sin(t)+ dirac(t-3*pi);
F=laplace(f,t,s);
Y1=s*Y-0;
Y2=s*Y1-0;
EQN= solve(Y2+2*Y1+3*Y-F,Y);
sol=ilaplace(EQN,s,t);
fplot(sol,[0,15]); xlabel('t')
title('13 (e) - Laplacian with Dirac delta function');
% Due to the forcing, the solution looks like a sine function till t =
 3Pi.
% At that instant there is an impulse function that is applied. That
```

```
% impulse causes the amplitude to increase just after t>3pi. After t >
% 3pi,the amplitude has increased slightly more as compared to the
 original
% amplitude.
```



QUESTION 3

14 (a)

```
syms s t Y
f = ['sin(t) - heaviside(t - 2*pi)*sin(t - 2*pi)'];
equation = sym(['D(D(y))(t) + 4*y(t) = ' f]);
ltequation = laplace(equation, t, s);
newequation = subs(ltequation,
 {'laplace(y(t),t,s)', 'y(0)',subs(diff(y,t),t,0)},{Y, 0, 0});
ytrans = solve(newequation, Y);
y = ilaplace(ytrans, s ,t);
fplot(y, [0 15])
title 'Solution', axis auto
fplot(f, [0 15])
title 'Forcing Factor', axis auto
% Due to the forcing, the solution looks like a sine function till t =
 2Pi.
% the step function is turns on when t = 2pi and sets the solution to
 zero
```

```
% for t>2pi. The unit step function turns the sine function off when t
 =
% 2pi.
```

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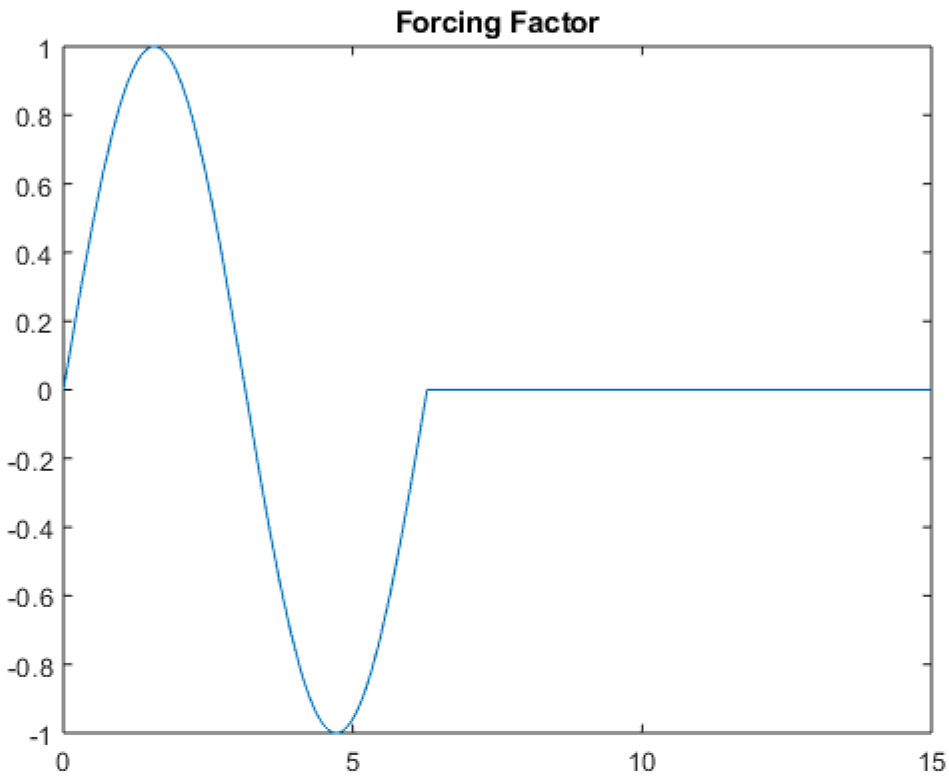
*Warning: Char input to fplot will be removed in a future release. Use fplot(@(t)sin(t)-heaviside(t-2.*pi).*sin(t-2.*pi)) instead.*



14 (c) attached towards the end

QUESTION 4

17 (a)

```
tic
syms y t
y='D2y+Dy+y=(t+1)^(3)*(exp(-t))*(cos(t))*(sin(3*t))';
solna =dsolve(y, 'y(0)=1', 'Dy(0)=0');
%sprintf('\n')
toc
```

```
Elapsed time is 12.742109 seconds.
```

17 (b)

```
tic
syms s t Y
eqn=sym('D(D(y))(t)+D(y)(t)+y(t)= (t+1)^(3)*(exp(-
t))*cos(t)*sin(3*t)');
lteqn=laplace(eqn,t,s);
neweqn=subs(lteqn,{'laplace(y(t),t,s)'...
'y(0)','D(y)(0)'},{Y,1,0});
ytrans=simplify(solve(neweqn,Y));
sprintf('\n')
y2=ilaplace(ytrans,s,t);
toc
```

```
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representing symbolic expressions, use 'str2sym'.

ans =
```

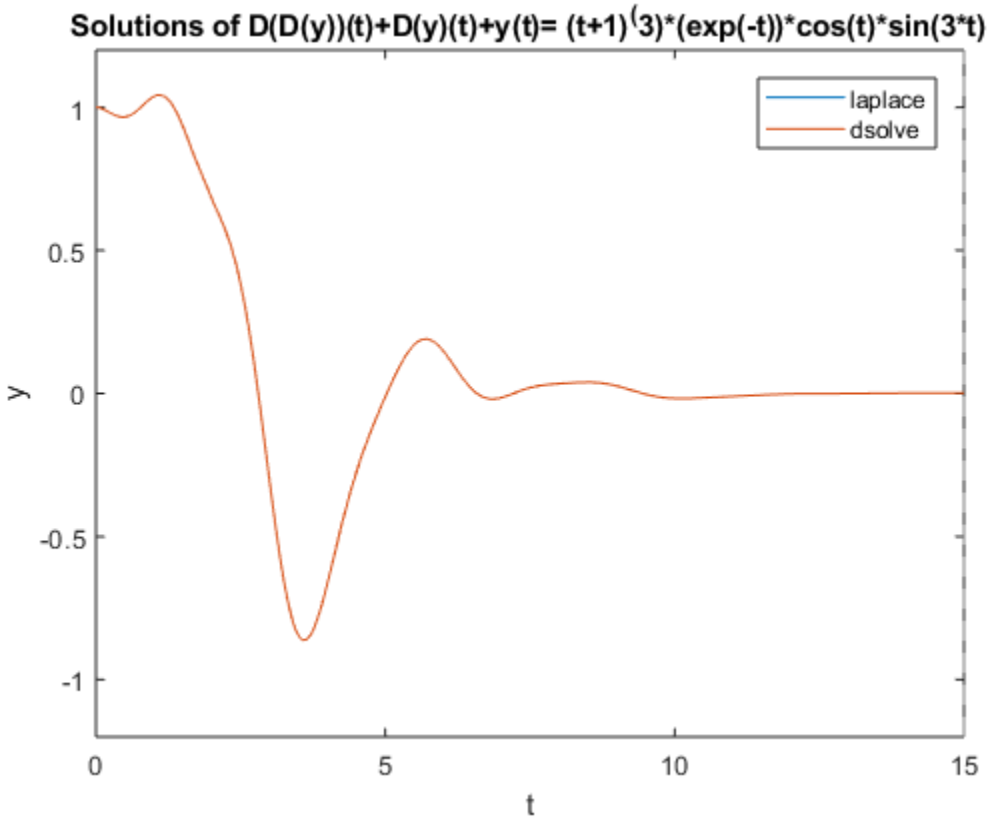
```
    '
     '
```

Elapsed time is 1.405361 seconds.

17 (c)

```
figure
fplot(y2,[0 15])
hold on
fplot(solna,[0 15])
hold off
title('Solutions of D(D(y))(t)+D(y)(t)+y(t)= (t+1)^(3)*(exp(-
t))*cos(t)*sin(3*t)')
xlabel 't'
ylabel 'y'
axis([0 15 -1.2 1.2])
legend ('laplace','dsolve')
% Both the graphs are the same
```

Warning: Finite sets ('DOM_SET') not supported. Using element 't = 0' instead.



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