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> # Quiz 11 solutions
> # Problem 1
> de:=-diff(u(t),t,t) = diff(X(t),t,t) + 16*diff(X(t),t) + 80* X(t)
;
> X:=t->10*cos(3*t);
> dsolve(de,u(t));subs(_C1=0,_C2=0,%);

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$$de := -\left(\frac{d^2}{dt^2} u(t)\right) = \frac{d^2}{dt^2} X(t) + 16 \left(\frac{d}{dt} X(t)\right) + 80 X(t)$$

$$X := t \rightarrow 10 \cos(3 t)$$

$$u(t) = \frac{710}{9} \cos(3 t) - \frac{160}{3} \sin(3 t) + _C1 t + _C2$$

$$u(t) = \frac{710}{9} \cos(3 t) - \frac{160}{3} \sin(3 t) \quad (1)$$

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> # answer check problem 2(a)
> f:=3*(t+1)^2*exp(2*t)+2*exp(t)*sin(3*t);
> with(inttrans): # load laplace package
> laplace(f,t,s);

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$$f := 3 (t + 1)^2 e^{2 t} + 2 e^t \sin(3 t)$$

$$\frac{3 (s^4 - 2 s^3 + 4 s^2 + 4)}{(s - 2)^3 ((s - 1)^2 + 9)}$$

(2)

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> convert(%,parfrac,s);

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$$\frac{6}{s^2 - 2 s + 10} + \frac{6}{(s - 2)^2} + \frac{6}{(s - 2)^3} + \frac{3}{s - 2}$$

(3)

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> # answer check problem 2(b)
> F:=4*s/(s^2+4)+(s-1)/(s^2-2*s+5);
> invlaplace(F,s,t);

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$$F := \frac{4 s}{s^2 + 4} + \frac{s - 1}{s^2 - 2 s + 5}$$

$$\cos(2 t) (4 + e^t)$$

(4)

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> # answer check problem 2(c)
> x:='x':de:=diff(x(t),t,t)+2*diff(x(t),t)+5*x(t)=exp(t);
ic:=x(0)=0,D(x)(0)=1;
> dsolve([de,ic],x(t));
> # answer check problem 2(c), partial fractions

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$$de := \frac{d^2}{dt^2} x(t) + 2 \left(\frac{d}{dt} x(t)\right) + 5 x(t) = e^t$$

$$ic := x(0) = 0, D(x)(0) = 1$$

$$x(t) = \frac{3}{8} e^{-t} \sin(2 t) - \frac{1}{8} e^{-t} \cos(2 t) + \frac{1}{8} e^t$$

(5)