

# Engineering Measurements Assignment 5

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## Assignment 5

### Problem 1

$$y'' - y' = 5 \sin(2x)$$

$$y'' - y' = 0$$

$$\lambda^2 - \lambda = 0$$

$$\lambda(\lambda - 1) = 0$$

$$y_h(x) = c_1 + c_2 e^x$$

$$f(x) = 5 \sin(2x)$$

$$f'(x) = 10 \cos(2x)$$

$$f''(x) = -20 \sin(2x)$$

$$f'''(x) = -40 \cos 2x$$

$$y_p(x) = A \sin(2x) + B \cos 2x$$

$$y_p'(x) = 2A \cos(2x) - 2B \sin(2x)$$

$$y_p''(x) = -4A \sin(2x) - 4B \cos(2x)$$

$$[-4A \sin(2x) - 4B \cos(2x)] - [2A \cos(2x) - 2B \sin(2x)]$$
$$(-4A + 2B) \sin 2x + (-2A - 4B) \cos 2x = 5 \sin 2x + 0 \cos 2x$$

$$-4A + 2B = 5$$

$$-2A - 4B = 0$$

$$A = -1$$

$$B = 1/2$$

$$y_p(x) = -\sin(2x) + 1/2 \cos(2x)$$

$$= c_1 + c_2 e^x - \sin(2x) + 1/2 \cos 2x$$

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```
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```

```
%Question 4
```

```
syms x a s
```

```
for x=0==1
    PartA=exp(-s^2);
    FTA=fourier(PartA)
    PartB=dirac(x-a);
    FTB=fourier(PartB)
    PartC=5*dirac(x-a);
    FTC=fourier(PartC)
    PartD=heaviside(x+a)-heaviside(x-a)
    FTD=fourier(PartD);
    PartE=diff(dirac(x-a));
    FTE=fourier(PartE)
end
```

```
FTA =
```

```
 $\pi^{1/2} \exp(-w^2/4)$ 
```

```
FTB =
```

```
1
```

```
FTC =
```

```
5
```

```
PartD =
```

```
 $\text{heaviside}(a) - \text{heaviside}(-a)$ 
```

```
FTE =
```

```
 $w \cdot 1i$ 
```

```
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```
%Question5
```

```
syms y t
```

```
f1 = t^14;
```

```
LPF=laplace(f1)
```

```
f2=t*sin(5*t);
```

```
LPG=laplace(f2)
```

```
f3=t*sinh(5*t);
```

```
LPH=laplace(f3)
```

```
f4=diff(y,t);
```

```
LPI=laplace(f4)
```

```
f5=diff(y,t,2);
```

```
LPJ=laplace(f5)
```

```
>> Untitled
```

```
LPF =
```

```
87178291200/s^15
```

```
LPG =
```

```
(10*s)/(s^2 + 25)^2
```

```
LPH =
```

```
(10*s)/(s^2 - 25)^2
```

```
LPI =
```

```
0
```

```
LPJ =
```

```
0
```

```
>> LPF
```

```
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```

```
%Question 6
```

```
syms s X x(t) Dx(t)
```

```
DE=diff(x,t,2)-4*diff(x,t)-5*x==1+exp(-t);
```

```
trans1=laplace(DE)
```

```
trans2=subs(trans1,laplace(x(t),t,s),X)
```

```
trans3=subs(trans2,x(0),0)
```

```
trans4=subs(trans3,subs(diff(x(t),t),t,0),0)
```

```
X=solve(trans4,X)
```

```
x=laplace(X)
```

trans1 =

$$4*x(0) - 4*s*\text{laplace}(x(t), t, s) - s*x(0) + s^2*\text{laplace}(x(t), t, s) - \text{subs}(\text{diff}(x(t), t), t, 0) - 5*\text{laplace}(x(t), t, s) == 1/(s + 1) + 1/s$$

trans2 =

$$4*x(0) - 5*X - 4*X*s - s*x(0) - \text{subs}(\text{diff}(x(t), t), t, 0) + X*s^2 == 1/(s + 1) + 1/s$$

trans3 =

$$X*s^2 - 4*X*s - 5*X - \text{subs}(\text{diff}(x(t), t), t, 0) == 1/(s + 1) + 1/s$$

trans4 =

$$X*s^2 - 4*X*s - 5*X == 1/(s + 1) + 1/s$$

X =

$$-(1/(s + 1) + 1/s)/(-s^2 + 4*s + 5)$$

x =

$$(11*\exp(-5*z)*(\log(-5*z) - \log(5) - \log(z) + \text{expint}(-5*z)))/180 + (5*\exp(z)*\text{expint}(z))/36 - \text{laplace}(1/s, s, z)/5 - \text{laplace}(1/(s + 1)^2, s, z)/6$$

Assignment 5

Problem 8

$$Z = \frac{mc}{h \lambda_s} = \frac{pV_0 c}{h \lambda_s} = \frac{p \left( \frac{4\pi r^3}{3} \right) c}{h (4\pi r^2)} = \frac{p c r}{3h} = \frac{8900 \times 944 \times r}{3(100)} = 13172 r$$

$$1 - e^{-Z} = 0.9$$

$$r = \frac{-Z}{13172 \ln 0.1}$$

$$a) r = \frac{-10}{13172 \ln 0.1} = 0.33 \text{ mm}$$

$$b) r = \frac{-1}{13172 \ln 0.1} = 0.033 \text{ mm}$$

$$c) r = \frac{-0.01}{13172 \ln 0.1} = 0.00330 \text{ mm}$$