Chapter 7 #: 1, 2, 3, 4, 8, 16, 21, 22, 28, 34

Problem 1

```
fprintf('Problem 1')
```

Problem 1

```
clear all
syms s t a b
eq1=laplace(1,t,s) %Laplace transform of 1
```

eq1 =

$\dfrac{1}{s}$

```
eq2=laplace(sin(b*t),t,s)
```

eq2 =

$\dfrac{b}{b^2 + s^2}$

```
f1=t*cos(b*t)
```

f1 = $t\cos(b\,t)$

```
eq3=laplace(f1,t,s)
```

eq3 =

$\dfrac{2\,s^2}{\left(b^2 + s^2\right)^2} - \dfrac{1}{b^2 + s^2}$

```
f2=exp(-a*t)*sin(b*t)
```

f2 = $e^{-a\,t}\sin(b\,t)$

```
eq4=laplace(f2,t,s)
```

eq4 =

$\dfrac{b}{\left(a + s\right)^2 + b^2}$

```
g1=1/(s^2+6*s+13)
```

g1 =

$\dfrac{1}{s^2 + 6\,s + 13}$

```
eq5=ilaplace(g1,s,t) %inverse Laplace transform
```

eq5 =

1

$$\frac{\sin(2\,t)\,e^{-3\,t}}{2}$$

```
g2=exp(-4*s)*(2/s^2+5/s)
```

g2 =

$$e^{-4\,s}\left(\frac{5}{s}+\frac{2}{s^2}\right)$$

```
eq6=ilaplace(g2,s,t)
```

eq6 = $5\,\text{heaviside}(t-4)+2\,\text{heaviside}(t-4)\,(t-4)$

Problem 2

```
fprintf('Problem 2')
```

Problem 2

```
clear all
syms s t a b
f1=dirac(t-3)
```

f1 = $\delta(t-3)$

```
eq0=int(f1,t,-inf,inf) %must be 1 by definition
```

eq0 = 1

```
eq1=laplace(f1,t,s)
```

eq1 = $e^{-3\,s}$

```
eq2=ilaplace(eq1,s,t)
```

eq2 = $\delta(t-3)$

```
f2=heaviside(t)
```

f2 = $\text{heaviside}(t)$

```
eq3=diff(f2,t)
```

eq3 = $\delta(t)$

```
eq4=int(f2,t)
```

eq4 =

$$\frac{t\,(\text{sign}(t)+1)}{2}$$

```
eq5=laplace(f2,t,s)
```

eq5 =

$$\frac{1}{s}$$

```
eq6=ilaplace(eq5,s,t)
```

eq6 = 1

```
f3=(2*t-3)*heaviside(t-4) %Heaviside function
```

f3 = $\mathrm{heaviside}(t-4)\,(2\,t-3)$

```
eq7=laplace(f3,t,s)
```

eq7 =

$$\frac{2\,e^{-4\,s}\left(\dfrac{5\,s}{2}+1\right)}{s^2}$$

```
eq8=ilaplace(eq7,s,t)
```

eq8 = $5\,\mathrm{heaviside}(t-4)+2\,\mathrm{heaviside}(t-4)\,(t-4)$

Problem 3

```
fprintf('Problem 3')
```

Problem 3

```
clear all
syms zeta wn F0 m s omega
zeta=sym('zeta','real')
```

zeta = ζ

```
zeta=sym('zeta','positive')
```

zeta = ζ

```
omega=sym('omega','real')
```

omega = ω

```
omega=sym('omega','positive')
```

omega = ω

```
wn=sym('wn','real')
```

wn = wn

```
wn=sym('wn','positive')
```

```
wn = wn
```

```
F0=sym('F0','real')
```

F0 = F_0

```
F0=sym('F0','positive')
```

F0 = F_0

```
m=sym('m','real')
```

m = m

```
m=sym('m','positive')
```

m = m

```
%observe b1=F0/m
H=(F0*s/m)/(s^2+2*zeta*wn*s+wn^2)
```

H =

$$\frac{F_0\,s}{m\,(s^2 + 2\,\zeta\,s\,\mathrm{wn} + \mathrm{wn}^2)}$$

```
g=subs(H,s,i*omega)
```

g =

$$\frac{F_0\,\omega\,\mathrm{i}}{m\,(-\omega^2 + 2\,\mathrm{i}\,\zeta\,\omega\,\mathrm{wn} + \mathrm{wn}^2)}$$

```
sqrt(simplify(g*conj(g)))
```

ans =

$$F_0\,\omega\,\sqrt{\frac{1}{\omega^4 + 4\,\omega^2\,\mathrm{wn}^2\,\zeta^2 - 2\,\omega^2\,\mathrm{wn}^2 + \mathrm{wn}^4}}$$
$$\frac{}{m}$$

Problem 4

```
fprintf('Problem 4')
```

```
Problem 4
```

```
clear all
syms s
P=(s^2+3*s+4)*(s^2+7*s+2)
```

P = $(s^2 + 3\,s + 4)\,(s^2 + 7\,s + 2)$

```
H=(s+1)/P
```

H =

$$\frac{s+1}{(s^2 + 3s + 4)(s^2 + 7s + 2)}$$

```
sol=solve(P,s)
```

sol =

$$\begin{pmatrix} -\frac{3}{2} - \frac{\sqrt{7}\,i}{2} \\ -\frac{3}{2} + \frac{\sqrt{7}\,i}{2} \\ -\frac{\sqrt{41}}{2} - \frac{7}{2} \\ \frac{\sqrt{41}}{2} - \frac{7}{2} \end{pmatrix}$$

```
eval(sol)
```

```
ans = 4×1 complex
  -1.5000 - 1.3229i
  -1.5000 + 1.3229i
  -6.7016 + 0.0000i
  -0.2984 + 0.0000i
```

Problem 8

```
fprintf('Problem 8')
```

Problem 8

```
clear all
syms s t a b
eq8=laplace(t*sin(5*t),t,s)
```

eq8 =

$$\frac{10\,s}{(s^2 + 25)^2}$$

Problem 16

```
fprintf('Problem 16')
```

Problem 16

```
f1=t*heaviside(t-1) %Heaviside function
```

f1 = $t\,\text{heaviside}(t - 1)$

```
eq16=laplace(f1,t,s)
```

eq16 =

$$\frac{e^{-s}}{s} + \frac{e^{-s}}{s^2}$$

Problem 21

```
fprintf('Problem 21')
```

Problem 21

```
g1=(2/(s+1))-(3/s^2)
```

g1 =

$$\frac{2}{s+1} - \frac{3}{s^2}$$

```
eq21=ilaplace(g1,s,t) %inverse Laplace transform
```

eq21 = $2\,e^{-t} - 3\,t$

Problem 22

```
fprintf('Problem 22')
```

Problem 22

```
g2=(exp(-s))-(3/s^3)
```

g2 =

$$e^{-s} - \frac{3}{s^3}$$

```
eq22=ilaplace(g1,s,t) %inverse Laplace transform
```

eq22 = $2\,e^{-t} - 3\,t$

Problem 28

```
fprintf('Problem 28')
```

Problem 28

```
clear all
syms zeta wn F0 m s omega
zeta= 1
```

zeta = 1

```
omega=sym('omega','real')
```

omega = ω

6

```
omega=sym('omega','positive')
```

omega = ω

```
wn=1/2
```

wn = 0.5000

```
F0=1
```

F0 = 1

```
m=4
```

m = 4

```
%observe b1=F0/m
H=(F0*s/m)/(s^2+2*zeta*wn*s+wn^2)
```

H =

$$\frac{s}{4\left(s^2+s+\frac{1}{4}\right)}$$

```
g=subs(H,s,i*omega)
```

g =

$$\frac{\omega\, i}{4\left(-\omega^2+\omega\, i+\frac{1}{4}\right)}$$

```
sqrt(simplify(g*conj(g)))
```

ans =

$$\frac{\omega}{4\,\omega^2+1}$$

Problem 34

```
fprintf('Problem 34')
```

Problem 34

```
clear all
syms s
P=(4*s^2+4*s+1)
```

P = $4\,s^2+4\,s+1$

```
H=(s)/P
```

H =

$$\frac{s}{4\,s^2 + 4\,s + 1}$$

```
sol=solve(P,s)
```

sol =

$$\begin{pmatrix} -\dfrac{1}{2} \\ -\dfrac{1}{2} \end{pmatrix}$$

```
eval(sol)
```

ans = 2×1
   -0.5000
   -0.5000