

Laplace Homework 9 CENG 5131 Due Nov 12

Problem 1

10 Points

Compute the Laplace transform of the following functions by direct integration:

(a) $f(t) = 2t$

(b) $f(t) = t - 3$

(c) $f(t) = 2 \sin t$

Problem 2

10 Points

Now compute the Laplace transform of the following functions by using the theorems, i.e. the shifting properties and the linearity property and the previous results in Problem 1:

(a) $f(t) = 3te^{3t}$

(b) $f(t) = e^{-2t} \cos 4t$

Problem 3

15 Points

By partial fraction expansion, after checking that the expansion is correct by multiplying the factors together, find the function $f(t)$ corresponding to the Laplace transform:

$$F(s) = \frac{120s}{(s-1)(s+2)(s^2-2s-3)}.$$

Problem 4

15 Points

Determine the solution of the following initial value problems using Laplace transforms and check the answer:

(a) $\frac{d^2y}{dt^2} + 4y = 0, \quad y(0) = 0, \quad y'(0) = 10.$

(b) $\frac{d^2y}{dt^2} + y = 2 \quad y(0) = 0, \quad y'(0) = 2.$

The MATLAB Symbolic Toolbox can be a great help. First, get help `>> help symbolic` or check out the demonstrations.

Demonstrations.

- `symintro` - Introduction to the Symbolic Toolbox.
- `symcalcdemo` - Calculus demonstration.
- `symlindemo` - Demonstrate symbolic linear algebra.
- `symvpademo` - Demonstrate variable precision arithmetic
- `symeqndemo` - Demonstrate symbolic equation solving.
- `mupadDemo` - Launcher for MuPAD demo notebooks

- `sym` - Create symbolic object.
- `syms` - Construct several symbolic objects (= `sym` for multiple variables).

- `simplify` - Simplify.
- `expand` - Expand.
- `factor` - Factor.
- `collect` - Collect.
- `simple` - Search for shortest form.
- `pretty(S)` - prints the symbolic expression S in a "nice" format.
- `diff` - Differentiate.
- `int` - Integrate.
- `symsum` - Summation of series.
- `taylor` - Taylor series.

- `solve` - Symbolic solution of algebraic equations.
- `dsolve` - Symbolic solution of differential equations.

Integral Transforms.

- `fourier` - Fourier transform.
- `laplace` - Laplace transform.
- `ztrans` - Z transform.
- `ifourier` - Inverse Fourier transform.
- `ilaplace` - Inverse Laplace transform.
- `iztrans` - Inverse Z transform.

- `dirac` - Delta function.
- `heaviside` - Step function.

- `ezplot` - Easy to use function and curve plotter.

Problem 5**10 Points**

Compute the Laplace transform of the following functions by using MATLAB symbolic command *laplace*:

(a) $f(t) = 2t$

(b) $f(t) = t - 3$

(c) $f(t) = 2 \sin t$

(d) $f(t) = 3te^{3t}$

Problem 6**20 Points**

By symbolic MATLAB, find the function $f(t)$ corresponding to the Laplace transform:

$$F(s) = \frac{120s}{(s-1)(s+2)(s^2-2s-3)}.$$

Problem 7**20 Points**

Determine the solution of the following initial value problem using *dsolve*

$$\frac{d^2y}{dt^2} + y = 2 \quad y(0) = 0, \quad y'(0) = 2.$$