EGR 261
Signals and Systems
File: N261H1

Due date: ______________________
(See Due Dates Table)

Homework Assignment #1

Reading Assignment:

Ch. 12, Sect. 1-9 in *Electric Circuits, 8th Edition* by Nilsson
Lathi: Chapter 4, Sections 1-3
Lathi: Sections B.5
Handout: Laplace Transform Properties and Common Laplace Transform Pairs
Lecture notes

Problem Assignment:

Notes:

- Avoid using calculators or software to find Laplace Transforms in this assignment since they will not be allowed on the test.
- Use the assigned **Problem Format** specified below (also see web page for an example).

> *PROBLEM FORMAT:*
> - Write out **all** given information with the problem, including problem statements, circuits, sketches, etc.,
> - Box your final answers
> - Include 3 significant digits with all non-integer answers
> - Present you work neatly
> - Work all problems in pencil (so that you can erase errors)
> - Include units with your final answers when appropriate
> - Use correct mathematical notation in your solutions

1. Work the following problems from Ch. 12 of *Electric Circuits, 8th Edition* by Nilsson: 1, 3, 13 (parts a, b, c, d only), 14, 19, 21, 41 (parts a, c only), 42 (parts a, c only)

2. Determine the Laplace transform of each function below using Laplace transform properties:

a) $(t^2 - 2t + 1)u(t)$ b) $(t + 2)^2u(t-1)$ c) $2t\cos(wt + b)u(t)$ d) $te^{-2t}u(t - 3)$

e) $3te^{-4t}\cos[2(t - 1)]u(t - 1)$ f) $\int_0^t \frac{\sin(x)}{x}dx$

Useful relationships:

$$\int \frac{dx}{x^2 + a^2} = \frac{1}{a}\tan^{-1}\left(\frac{x}{a}\right) \qquad \frac{\pi}{2} - \tan^{-1}(a) = \tan^{-1}\left(\frac{1}{a}\right)$$

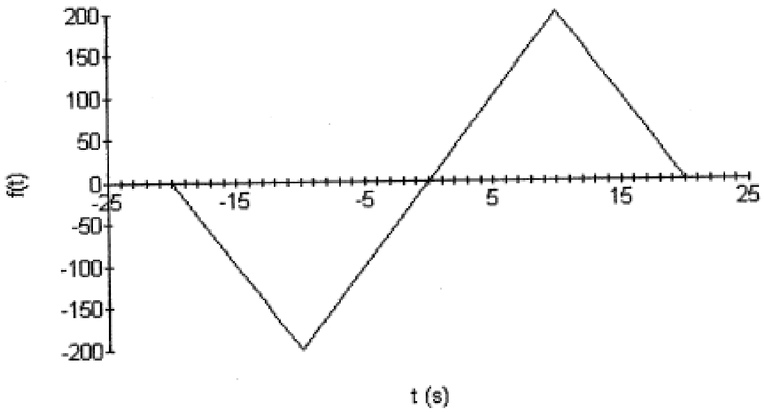
$$\cosh(x) = \frac{e^x + e^{-x}}{2} \qquad \sinh(x) = \frac{e^x - e^{-x}}{2} \qquad \cos(A + B) = \cos(B)\cos(A) - \sin(B)\sin(a)$$

3. If $f(t) = 4e^{-2t}u(t)$ and $g(t) = 2\cos(3t)u(t)$, determine $f(t) * g(t)$ using Laplace transforms.

4. Find the inverse Laplace transform of $$F(s) = \frac{6se^{-2s}}{s^2 + 4s + 3}$$

Selected Answers:

P 12.3



12.14) a) $\frac{1}{(s+a)^2}$ b) $\frac{s}{(s+a)^2}$ c) $\frac{s}{(s+a)^2}$

12.19) a) $L\{f(t)\} = \frac{4[1 - 2e^{-4s} + 2e^{-12s} - e^{-16s}]}{s^2}$

b) $L\{f'(t)\} = \frac{4[1 - 2e^{-4s} + 2e^{-12s} - e^{-16s}]}{s}$

c) $L\{f''(t)\} = 4[1 - 2e^{-4s} + 2e^{-12s} - e^{-16s}]$

12.21) a) $\frac{-20e^{-2s}}{s+5}$

b) $\frac{8[e^{-s} - 2e^{-2s} + 2e^{-4s} - e^{-5s}]}{s^2}$

12.42a) $f(t) = 10\delta(t) + [5e^{-t} + 20d^{-5t}]u(t)$

2) a) $\dfrac{s^2 - 2s + 2}{s^3}$ b) $\dfrac{e^{-s}(9s^2 + 6s + 2)}{s^3}$

c) $\dfrac{2[(s^2 - w^2)\cos(b) - 2 \cdot s \cdot w \cdot \sin(b)]}{(s^2 + w^2)^2}$

d) $\dfrac{e^{-3(s+2)}(3s+7)}{s^2 + 4s + 4}$ e) $\dfrac{3e^{-(s+4)}(s^3 + 13s^2 + 60s + 92)}{(s^2 + 8s + 20)^2}$

f) $\dfrac{1}{s}\tan^{-1}\left(\dfrac{1}{s}\right)$ g) $2\tan^{-1}\left(\dfrac{3}{s}\right)$

3) $f(t) = \dfrac{8}{13}[-2e^{-2t} + 2\cos(3t) + 3\sin(3t)]u(t)$

4) $f(t) = [-3e^{-(t-2)} + 9e^{-3(t-2)}]u(t-2)$