

EENG382 REFERENCE MATERIAL

TABLE OF LAPLACE TRANSFORMS

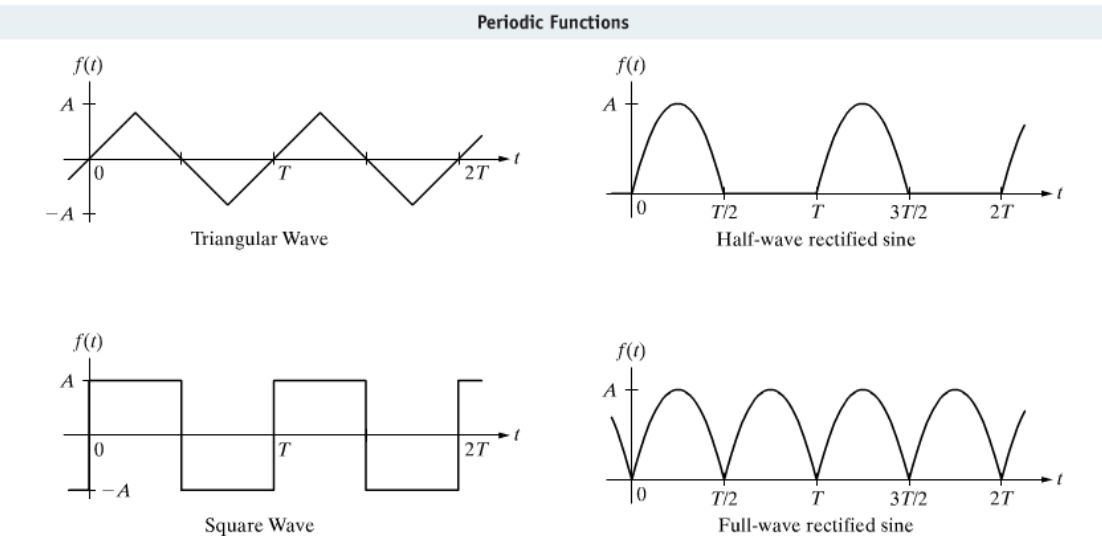
An Abbreviated List of Laplace Transform Pairs		
$f(t) (t > 0^-)$	Type	$F(s)$
$\delta(t)$	(impulse)	1
$u(t)$	(step)	$\frac{1}{s}$
t	(ramp)	$\frac{1}{s^2}$
e^{-at}	(exponential)	$\frac{1}{s+a}$
$\sin \omega t$	(sine)	$\frac{\omega}{s^2 + \omega^2}$
$\cos \omega t$	(cosine)	$\frac{s}{s^2 + \omega^2}$
te^{-at}	(damped ramp)	$\frac{1}{(s+a)^2}$
$e^{-at} \sin \omega t$	(damped sine)	$\frac{\omega}{(s+a)^2 + \omega^2}$
$e^{-at} \cos \omega t$	(damped cosine)	$\frac{s+a}{(s+a)^2 + \omega^2}$

An Abbreviated List of Operational Transforms	
$f(t)$	$F(s)$
$Kf(t)$	$KF(s)$
$f_1(t) + f_2(t) - f_3(t) + \dots$	$F_1(s) + F_2(s) - F_3(s) + \dots$
$\frac{df(t)}{dt}$	$sF(s) - f(0^-)$
$\frac{d^2 f(t)}{dt^2}$	$s^2 F(s) - sf(0^-) - \frac{df(0^-)}{dt}$
$\frac{d^n f(t)}{dt^n}$	$s^n F(s) - s^{n-1} f(0^-) - s^{n-2} \frac{df(0^-)}{dt} - s^{n-3} \frac{d^2 f(0^-)}{dt^2} - \dots - \frac{d^{n-1} f(0^-)}{dt^{n-1}}$
$\int_0^t f(x) dx$	$\frac{F(s)}{s}$
$f(t-a)u(t-a), a > 0$	$e^{-as} F(s)$
$e^{-at} f(t)$	$F(s+a)$
$f(at), a > 0$	$\frac{1}{a} F\left(\frac{s}{a}\right)$
$tf(t)$	$-\frac{dF(s)}{ds}$
$t^n f(t)$	$(-1)^n \frac{d^n F(s)}{ds^n}$
$\frac{f(t)}{t}$	$\int_s^\infty F(u) du$

TABLE OF FOURIER TRANSFORMS

Fourier Transforms of Elementary Functions	
$f(t)$	$F(\omega)$
$\delta(t)$ (impulse)	1
A (constant)	$2\pi A\delta(\omega)$
$\text{sgn}(t)$ (signum)	$2/j\omega$
$u(t)$ (step)	$\pi\delta(\omega) + 1/j\omega$
$e^{-at}u(t)$ (positive-time exponential)	$1/(a + j\omega)$
$e^{at}u(-t)$ (negative-time exponential)	$1/(a - j\omega)$
$e^{-a t }$ (positive- and negative-time exponential)	$2a/(a^2 + \omega^2)$
$e^{j\omega_0 t}$ (complex exponential)	$2\pi\delta(\omega - \omega_0)$
$\cos \omega_0 t$ (cosine)	$\pi[\delta(\omega + \omega_0) + \delta(\omega - \omega_0)]$
$\sin \omega_0 t$ (sine)	$j\pi[\delta(\omega + \omega_0) - \delta(\omega - \omega_0)]$

Operational Transforms	
$f(t)$	$F(\omega)$
$Kf(t)$	$KF(\omega)$
$f_1(t) - f_2(t) + f_3(t)$	$F_1(\omega) - F_2(\omega) + F_3(\omega)$
$d^n f(t)/dt^n$	$(j\omega)^n F(\omega)$
$\int_{-\infty}^t f(x) dx$	$F(\omega)/j\omega$
$f(at)$	$\frac{1}{a} F\left(\frac{\omega}{a}\right), a > 0$
$f(t - a)$	$e^{-j\omega a} F(\omega)$
$e^{j\omega_0 t} f(t)$	$F(\omega - \omega_0)$
$f(t) \cos \omega_0 t$	$\frac{1}{2} F(\omega - \omega_0) + \frac{1}{2} F(\omega + \omega_0)$
$\int_{-\infty}^{\infty} x(\lambda)h(t - \lambda) d\lambda$	$X(\omega)H(\omega)$
$f_1(t)f_2(t)$	$\frac{1}{2\pi} \int_{-\infty}^{\infty} F_1(u)F_2(\omega - u) du$
$t^n f(t)$	$(j)^n \frac{d^n F(\omega)}{d\omega^n}$



TRIG IDENTITIES

1. $\sin(\alpha \pm \beta) = \sin\alpha\cos\beta \pm \cos\alpha\sin\beta$

2. $\cos(\alpha \pm \beta) = \cos\alpha\cos\beta \mp \sin\alpha\sin\beta$

3. $\sin\alpha + \sin\beta = 2 \sin \frac{\alpha + \beta}{2} \cos \frac{\alpha - \beta}{2}$

4. $\sin\alpha - \sin\beta = 2 \cos\left(\frac{\alpha + \beta}{2}\right) \sin\left(\frac{\alpha - \beta}{2}\right)$

5. $\cos\alpha + \cos\beta = 2 \cos\left(\frac{\alpha + \beta}{2}\right) \cos\left(\frac{\alpha - \beta}{2}\right)$

6. $\cos\alpha - \cos\beta = -2 \sin\left(\frac{\alpha + \beta}{2}\right) \sin\left(\frac{\alpha - \beta}{2}\right)$

7. $2 \sin\alpha \sin\beta = \cos(\alpha - \beta) - \cos(\alpha + \beta)$

8. $2 \cos\alpha \cos\beta = \cos(\alpha - \beta) + \cos(\alpha + \beta)$

9. $2 \sin\alpha \cos\beta = \sin(\alpha + \beta) + \sin(\alpha - \beta)$

10. $\sin 2\alpha = 2 \sin\alpha \cos\alpha$

11. $\cos 2\alpha = 2 \cos^2\alpha - 1 = 1 - 2 \sin^2\alpha$

12. $\cos^2\alpha = \frac{1}{2} + \frac{1}{2} \cos 2\alpha$

13. $\sin^2\alpha = \frac{1}{2} - \frac{1}{2} \cos 2\alpha$

14. $\tan(\alpha \pm \beta) = \frac{\tan\alpha \pm \tan\beta}{1 \mp \tan\alpha \tan\beta}$

15. $\tan 2\alpha = \frac{2 \tan\alpha}{1 - \tan^2\alpha}$

TABLE OF INTEGRALS

1. $\int x e^{ax} dx = \frac{e^{ax}}{a^2}(ax - 1)$
2. $\int x^2 e^{ax} dx = \frac{e^{ax}}{a^3}(a^2 x^2 - 2ax + 2)$
3. $\int x \sin ax dx = \frac{1}{a^2} \sin ax - \frac{x}{a} \cos ax$
4. $\int x \cos ax dx = \frac{1}{a^2} \cos ax + \frac{x}{a} \sin ax$
5. $\int e^{ax} \sin bx dx = \frac{e^{ax}}{a^2 + b^2} (a \sin bx - b \cos bx)$
6. $\int e^{ax} \cos bx dx = \frac{e^{ax}}{a^2 + b^2} (a \cos bx + b \sin bx)$
7. $\int \frac{dx}{x^2 + a^2} = \frac{1}{a} \tan^{-1} \frac{x}{a}$
8. $\int \frac{dx}{(x^2 + a^2)^2} = \frac{1}{2a^2} \left(\frac{x}{x^2 + a^2} + \frac{1}{a} \tan^{-1} \frac{x}{a} \right)$
9. $\int \sin ax \sin bx dx = \frac{\sin(a-b)x}{2(a-b)} - \frac{\sin(a+b)x}{2(a+b)}, \quad a^2 \neq b^2$
10. $\int \cos ax \cos bx dx = \frac{\sin(a-b)x}{2(a-b)} + \frac{\sin(a+b)x}{2(a+b)}, \quad a^2 \neq b^2$
11. $\int \sin ax \cos bx dx = -\frac{\cos(a-b)x}{2(a-b)} - \frac{\cos(a+b)x}{2(a+b)}, \quad a^2 \neq b^2$
12. $\int \sin^2 ax dx = \frac{x}{2} - \frac{\sin 2ax}{4a}$
13. $\int \cos^2 ax dx = \frac{x}{2} + \frac{\sin 2ax}{4a}$
14. $\int_0^{\infty} \frac{a dx}{a^2 + x^2} = \begin{cases} \frac{\pi}{2}, & a > 0; \\ 0, & a = 0; \\ -\frac{\pi}{2}, & a < 0 \end{cases}$
15. $\int_0^{\infty} \frac{\sin ax}{x} dx = \begin{cases} \frac{\pi}{2}, & a > 0; \\ -\frac{\pi}{2}, & a < 0 \end{cases}$
16. $\int x^2 \sin ax dx = \frac{2x}{a^2} \sin ax - \frac{a^2 x^2 - 2}{a^3} \cos ax$
17. $\int x^2 \cos ax dx = \frac{2x}{a^2} \cos ax + \frac{a^2 x^2 - 2}{a^3} \sin ax$
18. $\int e^{ax} \sin^2 bx dx = \frac{e^{ax}}{a^2 + 4b^2} \left[(a \sin bx - 2b \cos bx) \sin bx + \frac{2b^2}{a} \right]$
19. $\int e^{ax} \cos^2 bx dx = \frac{e^{ax}}{a^2 + 4b^2} \left[(a \cos bx + 2b \sin bx) \cos bx + \frac{2b^2}{a} \right]$

COMMON COMPONENT VALUES

Resistors (5% tolerance)[Ω]					
10	100	1.0 k	10k	100k	1.0 M
	120	1.2 k	12 k	120 k	
15	150	1.5 k	15 k	150 k	1.5 M
	180	1.8 k	18 k	180 k	
22	220	2.2 k	22 k	220 k	2.2 M
	270	2.7 k	27 k	270 k	
33	330	3.3 k	33 k	330 k	3.3 M
	390	3.9 k	39 k	390 k	
47	470	4.7 k	47 k	470 k	4.7 M
	560	5.6 k	56 k	560 k	
68	680	6.8 k	68 k	680 k	6.8 M

Capacitors		
10 pF	22 pF	47 pF
100 pF	220 pF	470 pF
0.001 μ F	0.0022 μ F	0.0047 μ F
0.01 μ F	0.022 μ F	0.047 μ F
0.1 μ F	0.22 μ F	0.47 μ F
1 μ F	2.2 μ F	4.7 μ F
10 μ F	22 μ F	47 μ F
100 μ F	220 μ F	470 μ F

Inductors	
Value	Current Rating
10 μ H	3 A
100 μ H	0.91 A
1 mH	0.15 A
10 mH	0.04A