ENEL220 Term 3 Checklist 2019

Chapter 10

By the end of the Chapter 10 notes you should be able to:

- ☐ Do complex algebra.
- ☐ Analyse a circuit using phasors.

Chapter 14

By the end of the Chapter 14 notes you should be able to:

- ☐ Take the Laplace Transform of a function.
- ☐ Take the Inverse Laplace Transform of a function.
- ☐ Analyse a circuit with a damped sinusoidal input, R, L, and C components using the LT
- ☐ Analyse a circuit in the s-domain using techniques already learnt (e.g. mesh analysis, Norton's theorem etc).
- ☐ Work out the transfer function H(s) of a circuit.
- ☐ Work out the poles and zeroes of a circuit.
- ☐ Explain what convolution is.
- ☐ Work out the output of a circuit using convolution and the impulse response.

Exam Content

Remember you can look up old exams on the UC library website. These are a very good guide to the type of questions you are likely to get! Basic things to remember:

- ☐ Always show <u>all</u> working, even if you're doing something in your head, or if you think it's obvious (for example, write "by inspection"). This makes it easy for me to give you carried error marks if you make a silly mistake.
- ☐ Always put units on your answers!

Exam Formulas for Term 3 Material

Laplace Transform Pairs

$\mathbf{f(t) = \mathcal{L}^{-1}\{F(s)\}}$	$\mathbf{F(s) = \mathcal{L}\{f(t)\}}$	$\mathbf{f(t) = \mathcal{L}^{-1}\{F(s)\}}$	$\mathbf{F(s) = \mathcal{L}\{f(t)\}}$
$\delta(t)$	1	$\frac{1}{\beta - \alpha}\left(e^{-\alpha t} - e^{-\beta t}\right)u(t)$	$\frac{1}{(s+\alpha)(s+\beta)}$
$u(t)$	$\frac{1}{s}$	$\sin \omega t \, u(t)$	$\frac{\omega}{s^2 + \omega^2}$
$tu(t)$	$\frac{1}{s^2}$	$\cos \omega t \, u(t)$	$\frac{s}{s^2 + \omega^2}$
$\frac{t^{n-1}}{(n-1)!}u(t)$, n = 1,2,…	$\frac{1}{s^n}$	$\sin(\omega t + \theta)u(t)$	$\frac{s \sin \theta + \omega \cos \theta}{s^2 + \omega^2}$
$e^{-\alpha t}u(t)$	$\frac{1}{s+\alpha}$	$\cos(\omega t + \theta)u(t)$	$\frac{s \cos \theta - \omega \sin \theta}{s^2 + \omega^2}$
$te^{-\alpha t}u(t)$	$\frac{1}{(s+\alpha)^2}$	$e^{-\alpha t} \sin \omega t \, u(t)$	$\frac{\omega}{(s+\alpha)^2 + \omega^2}$
$\frac{t^{n-1}}{(n-1)!}e^{-\alpha t}u(t)$, n = 1,2,…	$\frac{1}{(s+\alpha)^n}$	$e^{-\alpha t} \cos \omega t \, u(t)$	$\frac{s+\alpha}{(s+\alpha)^2 + \omega^2}$

Laplace Transform Operations

Operation	$\mathbf{f(t)}$	$\mathbf{F(s)}$
Addition	$f_1(t) \pm f_2(t)$	$F_1(s) \pm F_2(s)$
Scalar Multiplication	$kf(t)$	$kF(s)$
Time Differentiation	$\frac{df}{dt}$	$sF(s) - f(0^-)$
	$\frac{d^2f}{dt^2}$	$s^2F(s) - sf(0^-) - f'(0^-)$
	$\frac{d^3f}{dt^3}$	$s^3F(s) - s^2f(0^-) - sf'(0^-) - f''(0^-)$
Time Integration	$\int_{0^-}^{t} f(t)\,dt$	$\frac{1}{s}F(s)$
	$\int_{-\infty}^{t} f(t)\,dt$	$\frac{1}{s}F(s) + \frac{1}{s}\int_{-\infty}^{0^-} f(t)\,dt$
Convolution	$f_1(t) * f_2(t)$	$F_1(s)F_2(s)$
Time Shift	$f(t-a)u(t-a), a \geq 0$	$e^{-as}F(s)$
Frequency Shift	$f(t)e^{-at}$	$F(s+a)$
Frequency Differentiation	$-tf(t)$	$\frac{dF(s)}{ds}$
Frequency Integration	$\frac{f(t)}{t}$	$\int_{s}^{\infty} F(s)\,ds$
Scaling	$f(at), a \geq 0$	$\frac{1}{a}F\left(\frac{s}{a}\right)$
Initial Value	$f(0^+)$	$\lim_{s\to\infty} sF(s)$
Final Value	$f(\infty)$	$\lim_{s\to 0} sF(s)$ All poles of $sF(s)$ in LHP
Time Periodicity	$f(t) = f(f + nT)$, n = 1,2,…	$\frac{1}{1-e^{-Ts}}F_1(s)$ Where $F_1(s) = \int_{0^-}^{T} f(t)e^{-st}\,dt$