ECE 45 WI25 Professor Heath
January 10, 2025 3:00PM
Andrew Onozuka A16760043
Homework #1

1) Mathematics Review

a) $\int_0^\infty e^{-t}dt = 1$

b) $\int_1^\infty e^{-t}dt = \frac{1}{e}$

c) $\int_{-1}^\infty e^{-t}dt = e$

d) $\int_{-\infty}^\infty e^{-2|t|}dt = 1$

e) $\int_0^\infty te^{-t}dt = 1$

f) $\int_0^\infty e^{-\beta t}dt = \{\frac{1}{\beta},\ if\ \beta > 0,\ DNE,\ if\ \beta \leq 0\}$

For this integral to converge, the exponential term $e^{-\beta t}$ must decay to 0 as $t \to \infty$. This happens when $\beta > 0$. If $\beta \leq 0$, the exponential term either remains constant ($\beta = 0$) or grows unbounded ($\beta < 0$), causing the integral to diverge.

g) $4 + 4j = 4\sqrt{2}(cos\frac{\pi}{4} + jsin\frac{\pi}{4}) = (4\sqrt{2},\ \frac{\pi}{4})$

h) $(4 + 3j) - (2 - 6j) = 2 + 9j$

$r = \sqrt{x^2 + y^2} = \sqrt{2^2 + 9^2} = \sqrt{85}$

$\Theta = tan^{-1}\frac{y}{x} = tan^{-1}(\frac{9}{2}) \approx 1.35\ radians$

$\sqrt{85}(cos\ 1.35 + jsin\ 1.35)$

i) $e^{jt} = cos\ t + jsin\ t \qquad e^{-jt} = cos\ t - jsin\ t$

$e^{jt} - e^{-jt} = (cos\ t + jsin\ t) - (cos\ t - jsin\ t) = 2jsin\ t$

$2e^{3jt} = 2cos\ (3t) + 2jsin\ (3t)$

$f(t) = 2cos\ (3t) + 2jsin\ t + 2jsin\ (3t)$

j) $g(t) = 1 + cos\ (t) + sin\ (2t)$

$g(t) = 1 + \frac{e^{jt}+e^{-jt}}{2} + \frac{e^{j2t}-e^{-j2t}}{2j}$

$g(t) = 1 + \frac{1}{2}e^{jt} + \frac{1}{2}e^{-jt} + \frac{1}{2j}e^{j2t} - \frac{1}{2j}e^{-j2t}$

k) $A = 4,\ Phase = -\frac{\pi}{4}$

$V = 4e^{-j\frac{\pi}{4}}$

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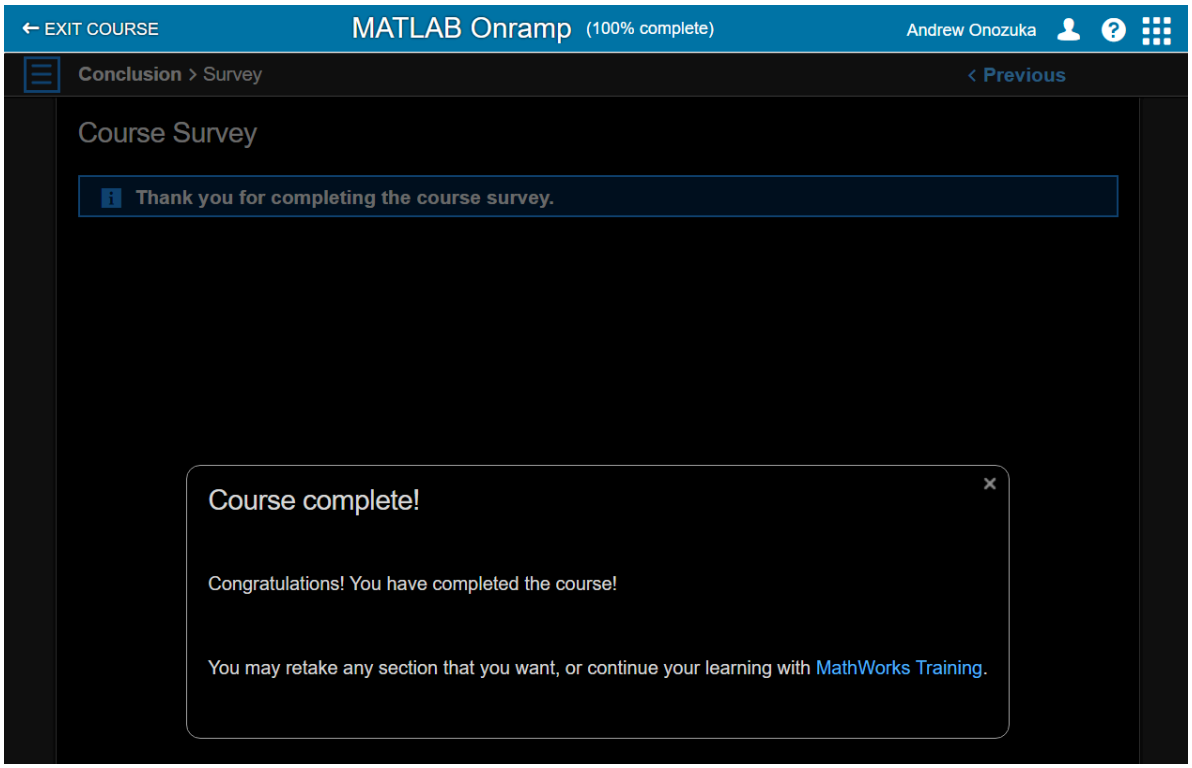
2) MATLAB Onramp



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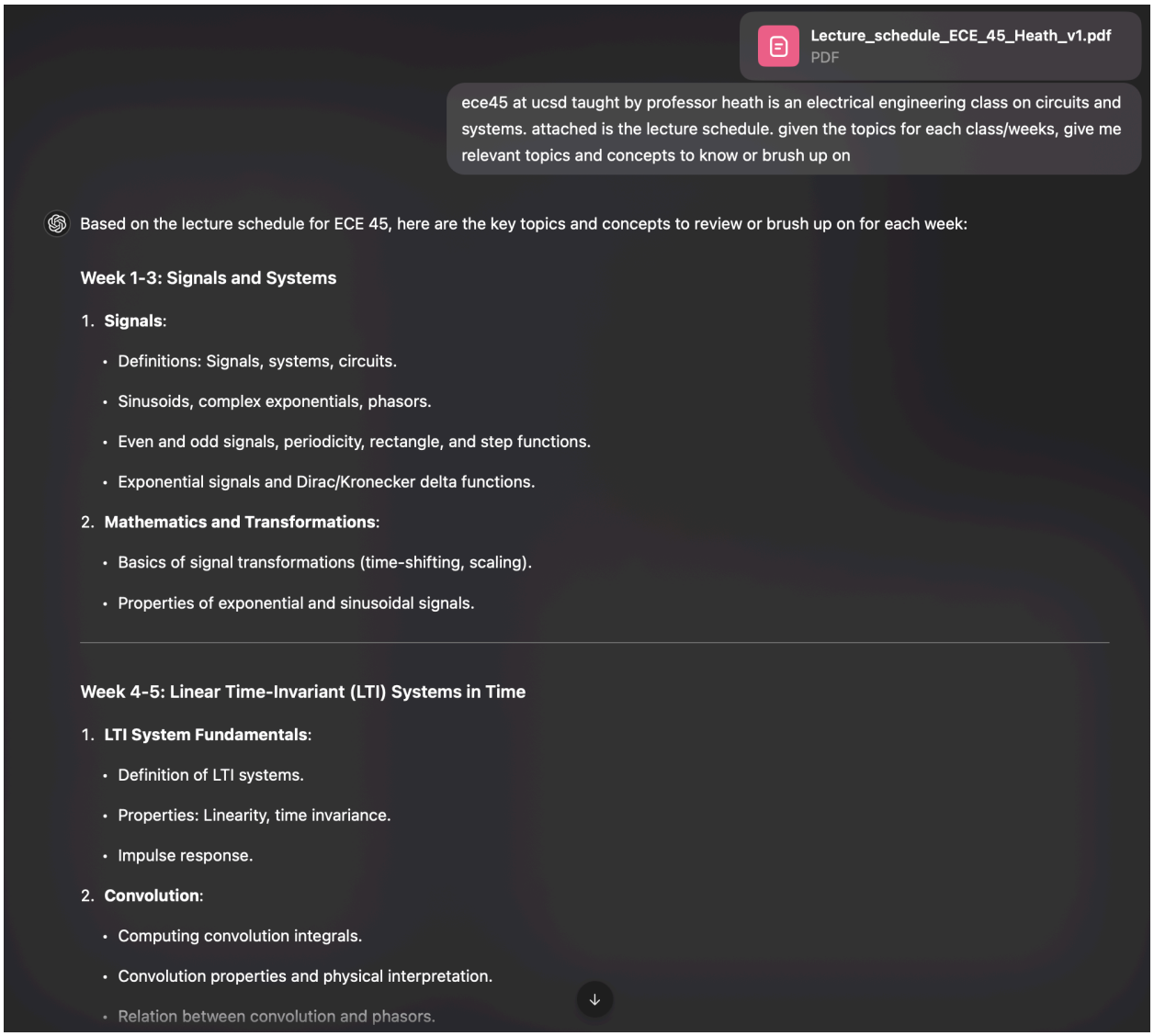
3) AI Prompt Sequence



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- Convolution properties and physical interpretation.
- Relation between convolution and phasors.

Week 6-7: Fourier Series

1. **Fourier Series**:
   - Basic formulation.
   - Trigonometric and exponential forms.
   - Convergence properties and practical applications.
2. **Properties**:
   - Linearity, symmetry, time-shifting, frequency-shifting.

Week 8-10: LTI Systems in Frequency

1. **Frequency Response**:
   - Deriving and interpreting the frequency response.
   - Filters (low-pass, high-pass, band-pass).
   - Bode plots: Gain and phase plots.

Week 11-14: Fourier Transform

1. **Fourier Transform Basics**:
   - Transforming signals from time to frequency domain.
   - Sinc functions, rectangular functions, and their transforms.
   - Convolution in the Fourier domain.
2. **Properties**:
   - Linearity, scaling, duality.
   - Multiplication and convolution properties.

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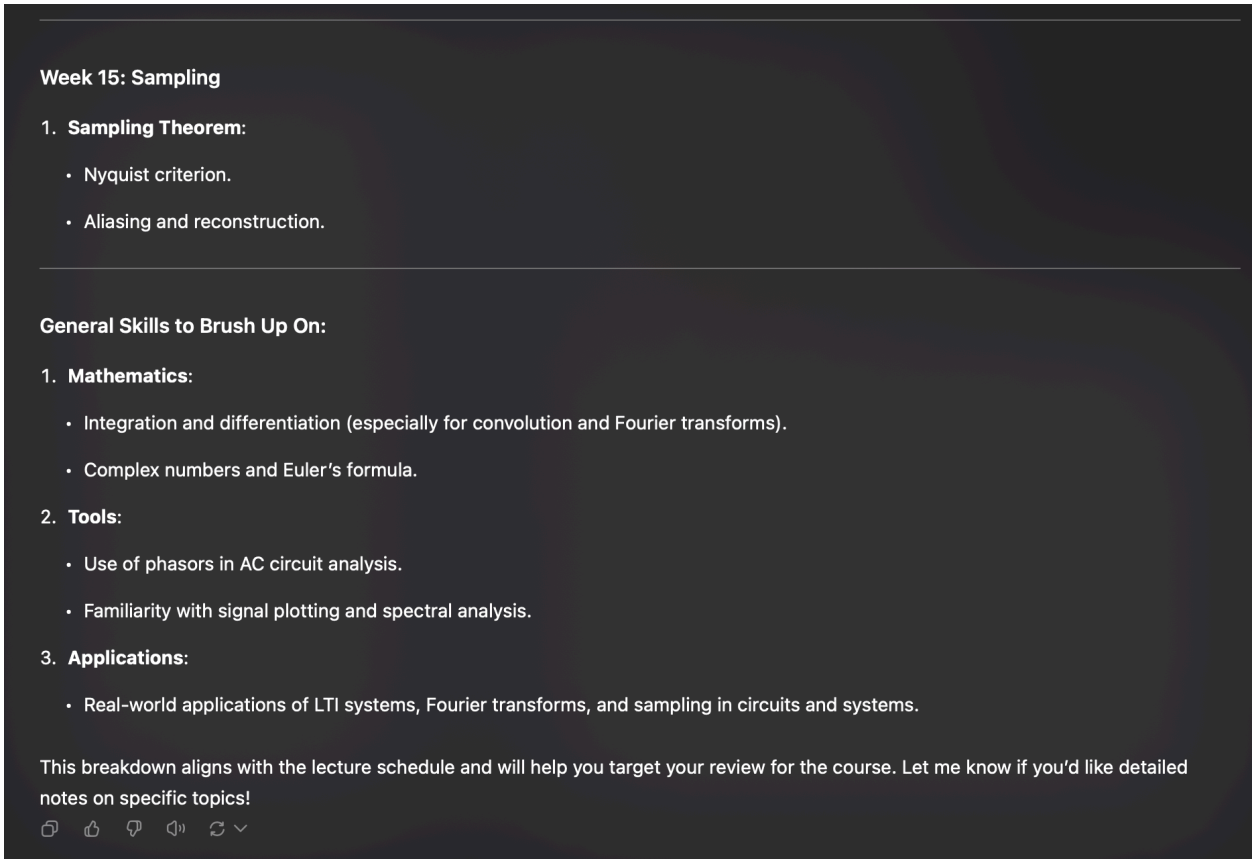

Week 15: Sampling

1. **Sampling Theorem**:
   - Nyquist criterion.
   - Aliasing and reconstruction.

General Skills to Brush Up On:

1. **Mathematics**:
   - Integration and differentiation (especially for convolution and Fourier transforms).
   - Complex numbers and Euler's formula.
2. **Tools**:
   - Use of phasors in AC circuit analysis.
   - Familiarity with signal plotting and spectral analysis.
3. **Applications**:
   - Real-world applications of LTI systems, Fourier transforms, and sampling in circuits and systems.

This breakdown aligns with the lecture schedule and will help you target your review for the course. Let me know if you'd like detailed notes on specific topics!

4) Acknowledgments

I acknowledge that I have read through and reviewed all of the course policies from the syllabus including but not limited to the requirement of marking problems on GradeScope and no late submissions.