Homework #1: Mathematics Review (due Sep. 2, 2016)

Preliminary

- As a reminder, EE312 office hours are:
  - Prof. De Leon (Goddard Annex 160G) Wednesday 9:00-10:00am and Thursday 3:00-4:00pm
  - Chris Trujillo (Thomas and Brown 205B) Friday 9:30 - 10:30am
- Please direct all email to pdeleon@nmsu.edu (do not send email via Canvas). All requests for bonus points will receive a confirmation email within 48 hours.
- In order to receive full credit for homework problems, you must provide a detailed solution. Simply writing a few, summarized steps toward the answer will result in minimal credit.
- All problems are worth +10 points unless otherwise noted.

Problems

1. $\int_0^t \tau d\tau$
2. $\int_0^1 te^{-t/2}dt$
3. $\int_0^\infty e^{-t/2}dt$
4. $\int_{-\pi}^{\pi} e^{-jk\omega t}dt$ where $j \equiv \sqrt{-1}$. Express your answer in terms of sin( ) by using $\sin(x) = \dfrac{e^{jx} - e^{-jx}}{j2}$.
5. $\lim_{x\to 0} \dfrac{e^x - x - 1}{x^2}$ (see [1])
6. $\lim_{x\to \pi/2} \dfrac{\cos x}{\pi - 2x}$ (see [1])
7. (Text prob. 1.54b) Show that if $|\alpha| < 1$, then $\sum_{n=0}^{\infty} \alpha^n = \dfrac{1}{1-\alpha}$ (see [2]).
8. (Text prob. 1.54a) Show the following is true (see [2]):

$$\sum_{n=0}^{N-1} \alpha^n = \begin{cases} N, & \alpha = 1 \\ \frac{1-\alpha^N}{1-\alpha}, & \text{for any complex number } \alpha \neq 1 \end{cases}$$

9. Determine the partial fraction coefficients A, B (see [3]): $\dfrac{1}{(x+1)(x+2)} = \dfrac{A}{x+1} + \dfrac{B}{x+2}$
10. Determine the partial fraction coefficients A, B (see [3]): $\dfrac{x+1}{(x+2)(x+3)} = \dfrac{A}{x+2} + \dfrac{B}{x+3}$
11. Determine the solution y to the following differential equation. Assume for your solution that when $x = 0$, $y = 1$.

    $\dfrac{dy}{dx} + 2y = e^x$

12. Let $f(x) = \frac{1}{1+jx}$. Graph $|f(x)|$ vs. x for $0 \leq x < \infty$ [$|f(x)|$ denotes magnitude of $f(x)$]. Be sure to carefully label your plot and note the values of $|f(0)|$, $|f(1)|$, and $|f(\infty)|$.

13. Let $f(x) = \frac{1}{1+j10x}$. Graph $|f(x)|$ vs. x for $0 \leq x < \infty$. Be sure to carefully label your plot and note the values of $|f(0)|$, $|f(1)|$, and $|f(\infty)|$.

14. Convert the following complex numbers in polar form to rectangular form (see [4])
    e^{j0}, $e^{j\pi/4}$, $e^{j\pi/2}$, $e^{j3\pi/4}$, $e^{j\pi}$, $e^{-j\pi}$, $e^{j2\pi}$

15. Convert the following complex numbers in rectangular form to polar form (see [4])
    1, $1+j$, j, $1-j$, -1, $-j$

References

[1] http://en.wikipedia.org/wiki/L'Hospital's_rule

[2] http://en.wikipedia.org/wiki/Geometric_series

[3] A. V. Oppenheim and A. S. Willsky, *Signals & Systems* 2/E, Appendix A.

[4] http://en.wikipedia.org/wiki/Euler's_identity