

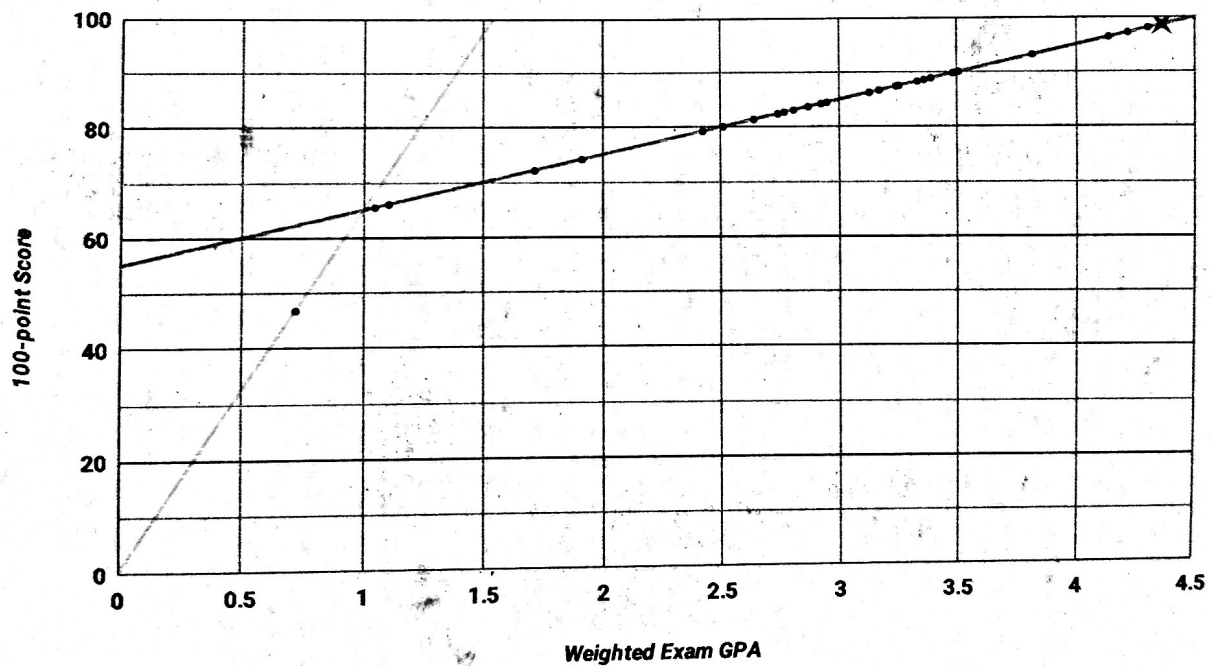
Goulette, Spencer

	Problem Grade	Grade Points	Weight
Problem 1	A+	4.50	25%
Problem 2	A-	3.67	17%
Problem 3	A+	4.50	17%
Problem 4	A+	4.50	17%
Problem 5	A+	4.50	24%

Weighted Exam GPA:	4.36
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GPA > 1.0: Recorded 100-pt Score = $65.0 + 10.0(\text{GPA} - 1.0)$

GPA < 1.0: Recorded 100-pt Score = $65.0(\text{GPA})$

GPA to 100-point score mapping

Recorded 100-point max score:	98.58	A+
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(90/80/70/60 Scale)

Class Average GPA: 3.09

Class Average 100-pt score: 85.40

ECE-486 Test 1, Jan 31, 2019
1 Hour; Closed book; No Calculators

Name: Spencer Coulette

1. (20%) Evaluate the following expressions to give numerical results in the form $x + jy$, where x and y are real. (Or just provide the numerical value for a real result.)

✓ (a) $\left| \frac{3e^{j\pi/8}}{4 + j3} \right| = \frac{|3e^{j\pi/8}|}{\sqrt{4^2 + 3^2}} = \boxed{\frac{3}{5}}$ ✓

✓ (b) $\frac{-1 + j1}{e^{-j3\pi/4}} = \frac{\sqrt{2}e^{j3\pi/4}}{e^{-j3\pi/4}} = \sqrt{2}e^{j6\pi/4} = \boxed{-j\sqrt{2}}$ ✓

✓ (c) $2 + \sqrt{2}e^{j\pi/4} = 2 + 1 + j1 = \boxed{3 + j1}$ ✓

✓ (d) $e^{(-1+j\pi)} = e^{-1}e^{j\pi} = \boxed{-\frac{1}{e}}$ ✓

✓ (e) $\left| \frac{2+j}{3-j} \right| = \frac{\sqrt{2^2 + 1^2}}{\sqrt{3^2 + 1^2}} = \frac{\sqrt{5}}{\sqrt{10}} = \boxed{\sqrt{\frac{1}{2}}}$ ✓

A+

2. (15%) Simplify the following expression to a purely real function of the variable n .

$$\begin{aligned}
 x[n] &= (1 + j1)^n + (1 - j1)^n \\
 x[n] &= (e^{j\pi/4})^n + (e^{-j\pi/4})^n \\
 x[n] &= e^{j\pi/4 n} + e^{-j\pi/4 n} \\
 x[n] &= 2 \left(\frac{e^{j\pi/4 n} + e^{-j\pi/4 n}}{2} \right) \\
 x[n] &= 2 \cos(\pi/4 \cdot n)
 \end{aligned}$$

3. (15%) Find the "fifth roots of one": Find five different complex numbers x such that $x^5 = 1$.

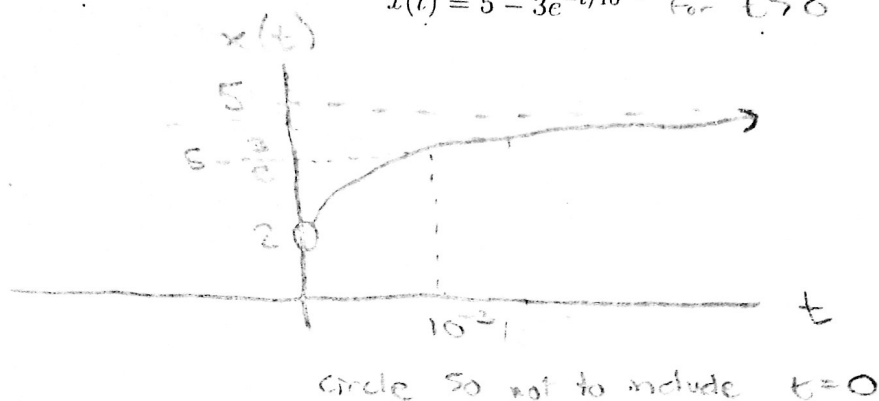
$$\begin{aligned}
 x &= 1 \\
 x &= e^{j2\pi/5} \\
 x &= e^{j4\pi/5} \\
 x &= e^{j6\pi/5} \\
 x &= e^{j8\pi/5}
 \end{aligned}$$

$$\begin{aligned}
 e^{j5\gamma} &= e^{j2\pi} \\
 2\pi/5 \cdot 5 &= 2\pi \\
 4\pi/5 \cdot 5 &= 4\pi \\
 6\pi/5 \cdot 5 &= 6\pi \\
 8\pi/5 \cdot 5 &= 8\pi
 \end{aligned}$$

B*

4. (15%) Sketch and carefully label function $x(t)$ for $t > 0$. (Include values and units on your axes).

$$x(t) = 5 - 3e^{-t/10^{-3}} \text{ for } t > 0$$



5. (15%) Determine the maximum value, and the time at which the maximum occurs, for the function

$$x(t) = te^{-5t} \quad t > 0$$

$$x'(t) = e^{-5t} + -5te^{-5t}$$

$$e^{-5t} + -5te^{-5t} = 0$$

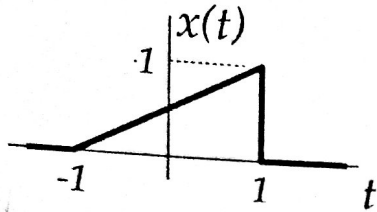
$$e^{-5t} = 5te^{-5t}$$

$$1 = 5t \Rightarrow t = \frac{1}{5}$$

$$x(t) = \left(\frac{1}{5}\right)e^{-5(1/5)}$$

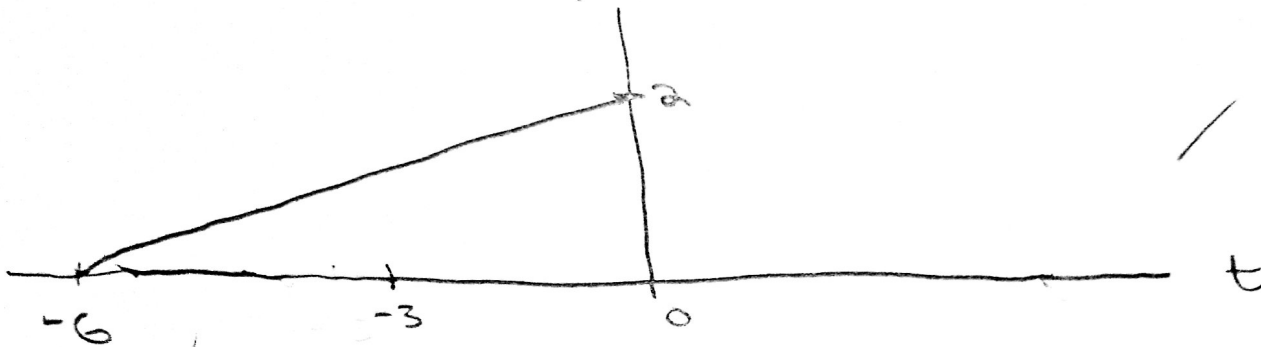
$$x(t) = \frac{1}{5e}$$

6. (20%) The function $x(t)$ is plotted below



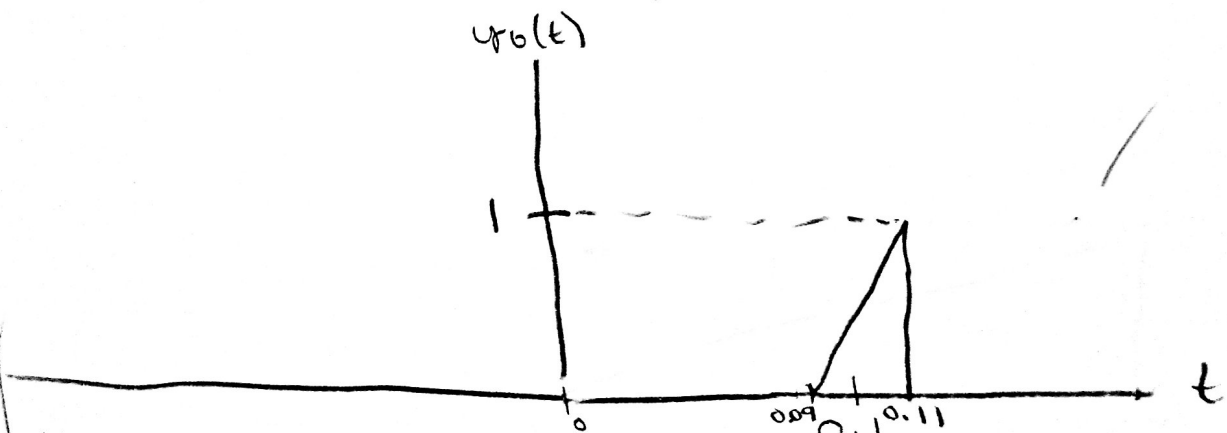
(a) Plot $y_a(t) = 2x(t/3 + 1)$.

$$y_a(t) = 2x\left(\frac{1}{3}(t+3)\right)$$

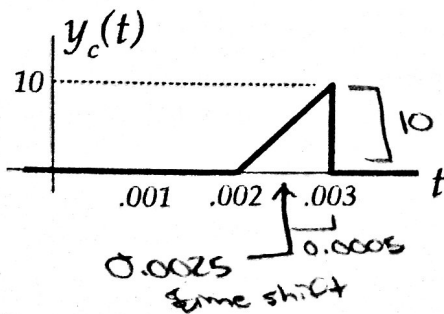


(b) Plot $y_b(t) = x(10^2(t - 0.1))$.

$$y_b(t) = x(10^2(t - 0.1))$$



(c) Using linear scales, time scales, and time shifts, express the function $y_c(t)$ in terms of the function $x(t)$.



$$y_c(t) = 10x(2 \cdot 10^3(t - 0.0025))$$

$$\frac{1}{0.0005} = 2000$$