EE103 Final Examination

Dec. 12, 2017 4:00-7:00 p.m.

Name________________________ ID___________________________

i. You are allowed to use **2 pages of formulas and tables**, but not any concept descriptions or derivations.

ii. Please fill the score blanks below:

Qz1____________ Qz2____________ Qz3______________ Qz4 _____________
Qz5 ____________ Qz6 ___________ Qz7 _____________ Qz8 _____________

Delete two lowest scores and provide the average of 6 quizzes in 2 decimal points Average= _________.______

Midterm Exam Score (modified)= _________.______

Iii. The final course grade will be based on the following weights

Quiz Average 20%

Midterm Exam 30%

Final Exam 50%

Final Exam provides 6 Problems

[1] 20 points _____________

[2] 15 points _____________

[3] 20 points _____________

[4] 20 points _____________

[5] 20 points _____________

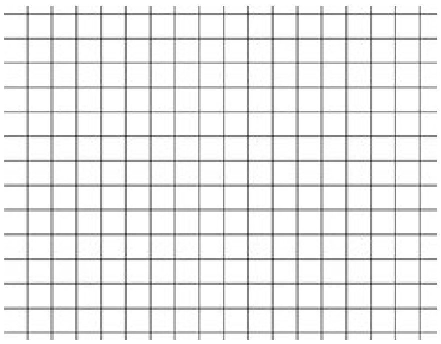
[6] 5 points _____________

Total 100 points _____________

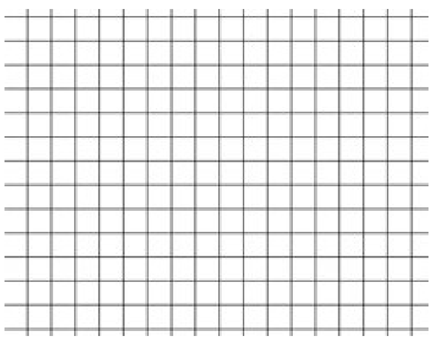
[1] (20points) Given a function $x(t) = 2(t + 1)\, u(t+1) - 2t\, u(t) - 2\, u(t-2)$

a new function $x1(t)$ is defined as **$x1(t) = 2\, x_{even}(t) + x_{odd}(t)$.**

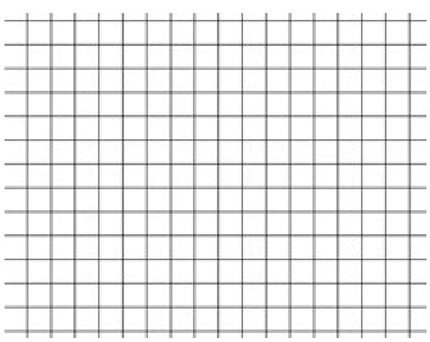
Plot $x_{even}(t)$, $x_{odd}(t)$ and $x1(t)$ on the graph below.



plot $x_{even}(t)$ here (5 points)



plot $x_{odd}(t)$ here (5 points)

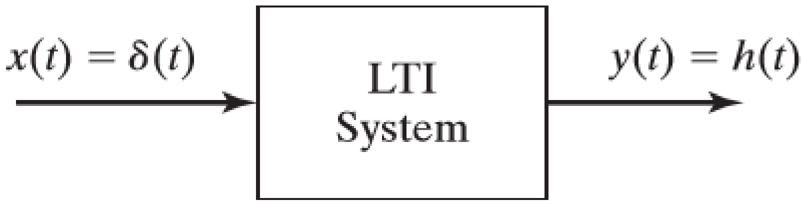


plot $x1(t)$ here (5 points)

Express x1(t) mathematically

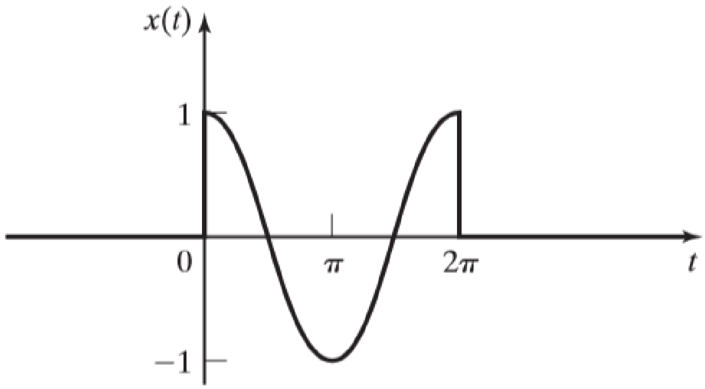
____(5points)

[2] (15 points) A linear time-invariant (LTI) system is described represented below.



For h(t) = $e^{-3t}\ u(t)$ and x(t) = rect (t|2)**, find y(t) by using y(t)= x(t) * h(t) = h(t) * x(t).**

[3] (30 points) A windowed function is plotted below.



(a) (10 points) **Write down a mathematical description of x(t)** by using the cosine and rectangular functions.

x(t) = (   ) x (   )

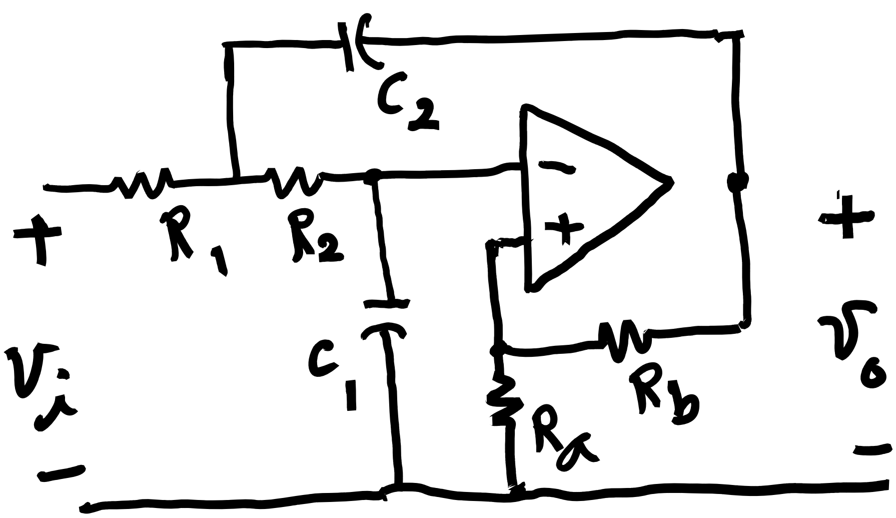
Let x1(t) = x (t) x $\sum_{k=-\infty}^{\infty} \delta(t - k3\pi)$

(b) (20 points) **Find Fourier transform of x1(t).**

Step 1 (10pts) First find X(ω)

Step 2 (10pts) Find X1(ω)

[4] (20 points) Let us consider the following OP amp circuit.



Let C1 = 2 C2 = 1 μF, all resistance values are 1MΩ

(a) (15points) **Find H(s) = Vo(s)/Vi(s)**

(b) (5 points) **Find h(t)** by taking inverse Laplace transform of H(s).

[5].(20 points) The following figure show a Bode plot of a band-pass filter.

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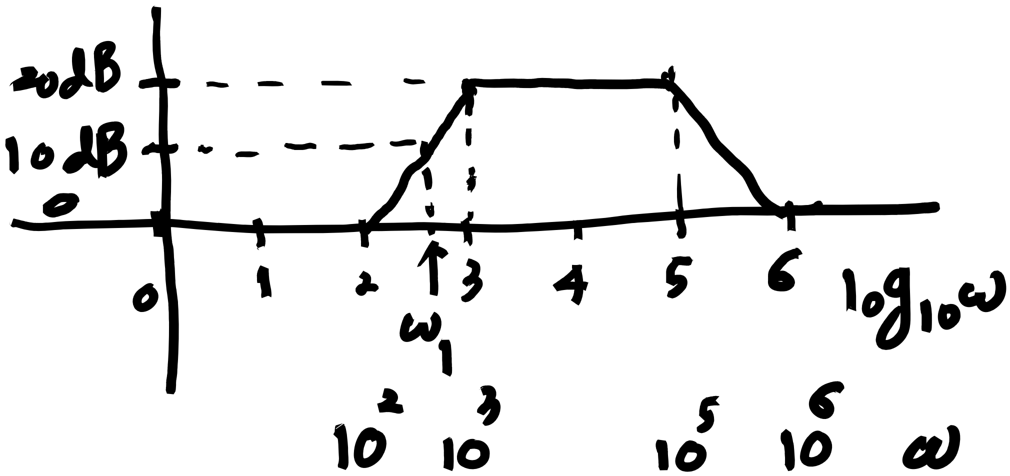

At ω = ω1, the gain in dB is 10 dB.

(a). (10 points) Find the corresponding H(jω) with identification of all zero and pole (angular) frequencies. Hint: **H(jω)= K (1 + j ω/ωz) / [(1 + j ω/ωp1) (1 + j ω/ωp2)]** and ω1 can be found from **H(jω)**

(b).(5points) **Find H(s)** by replacing jω by s and simplifying the terms such that

H(s)= M (N(S)/D(s)), N(s) and D(s) are polynomial functions of s.

(c) (5 points) **Find output y(t)** for x(t) = 10cos $(100\sqrt{10}\,t + \Theta 1)$ + 5cos (10000t + Θ2).

Hint: y(t) = A1 cos $(100\sqrt{10}\,t$ + Θy1) + A2 cos (10000t + Θy2)

Find A1. A2 from the gain information in the Bode plot. For simplicity neglect Θy1,2.

Also, use an approximation as I1 + j K I = K for K > 3.

[6] (5 points) Describe **most significant concepts** you have learned from EE103 in the Fall 2017 quarter.