EECS 120. Midterm No. 2, March 24, 2000. 90 mins.

Please use these sheets for your answer. Add extra pages if necessary and staple them to these sheets. **Write clearly and put a box around your answer, and show your work.**

Print your name and SID below

Last Name _____ First _____ SID _____

Problem 1:

Problem 2:

Problem 3:

Problem 4:

Problem 5:

Total:

1. **20 points**

   (a) Plot the Fourier Transform $X(\omega)$ of a signal $x \in ContSignals$ whose total energy is 2 and such that $X(\omega) = 0$ for $|\omega - 2\pi| > \pi$.

   (b) Now find the time-domain signal x by taking the inverse FT of X.

2. **15 points** Fill in the blanks.

   (a) The LT of $x(t) = tu(t)$ is _____ and its ROC is _____.

   (b) The LT of $x(t) = e^{-t}u(t)$ is _____ and its FT is _____.

   (c) The transfer function $H(s) = \frac{s-1}{s+1}$ of an LTI system has a pole at _____ and its impulse response is $h(t) =$ _____.

3. **20 points** Find the solution $y(t), t \geq 0$, of the differential equation

$$\ddot{y}(t) - 3\dot{y}(t) + 2y(t) = 0,$$

with initial condition $y(0-) = 1, \dot{y}(0-) = 1$. Check that your solution satisfies these initial conditions.

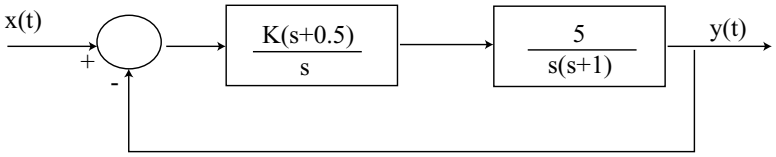

Figure 1: System for Problem 4

4. **20 points** In Figure 1 K is a real constant. Find the closed-loop transfer function $H(s)$. Use the Routh test to determine the values of K for which H is stable.

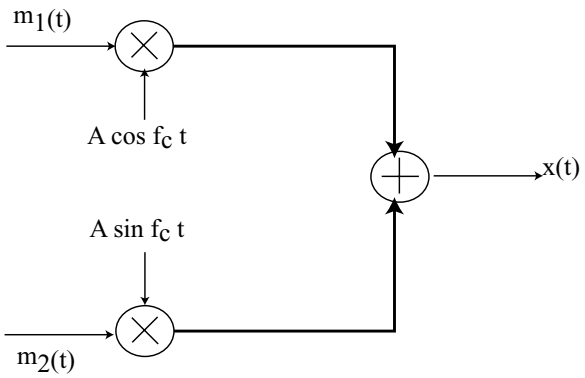

Figure 2: System for Problem 5

5. **25 points** In Figure 2 m_1 and m_2 are real signals with real Fourier Transforms $M_1(f)$ and $M_2(f)$ respectively. Suppose that $M_i(f) = 0$, for $|f| > 15$ kHz. The carrier frequency $f_c = 100$ kHz.

   (a) Determine the Fourier Transform $X(f)$ of the modulated signal x. Write an expression for $|X(f)|$. What is the bandwidth of x?

   (b) Find a scheme to demodulate x and recover both signals m_1 and m_2. Prove that your scheme works.