

**6.003: Signals and Systems—Fall 2003**

PROBLEM SET 8

Issued: November 4, 2003

Due: November 19, 2003

**REMINDER:** Quiz #2 will be held from 7:30 - 9:30 p.m. Thursday, November 13 in Walker Memorial. The quiz will cover materials in Chapters 4 -7 (through Section 7.4) of O&W, Lectures and Recitations through October 29, Problem Sets # 4-6, and that part of Problem Set # 7 involving problems from Chapter 7.

**Reading Assignments:**

**Lectures #16-18 & PS#8:** Section 7.5, Chapters 8 & 9 (through Section 9.6) of O&W

**Lectures #18-20 & PS#9:** Chapters 9 & 11 (through Subsection 11.3.4) of O&W

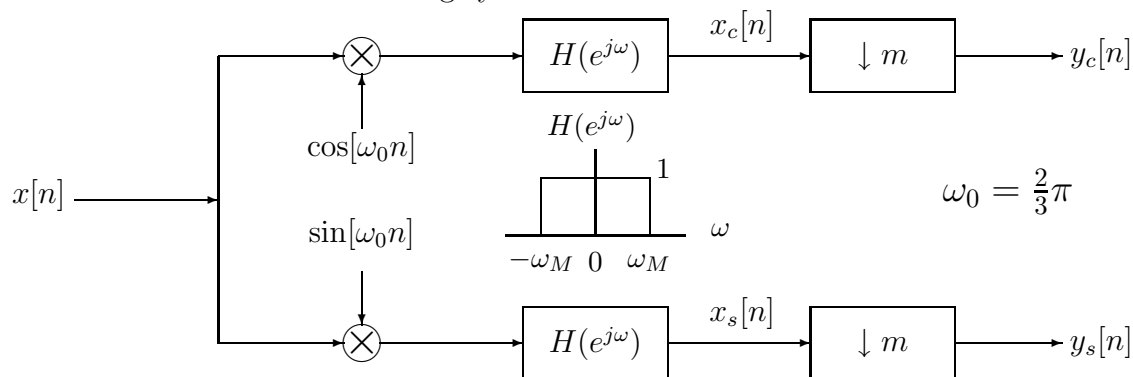
**Exercise for home study (not to be turned in, although we will provide solutions):**

O&W 8.35

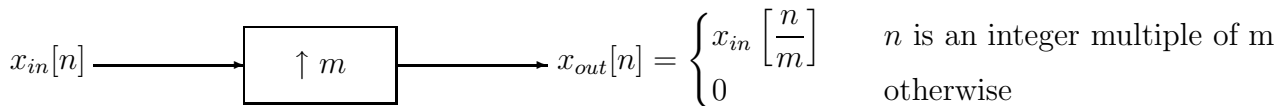
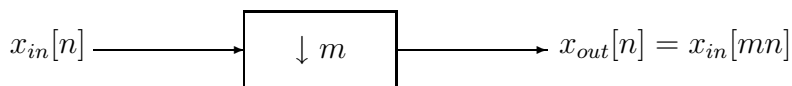
**Problems to be turned in:**

**Problem 1** O&W 7.34

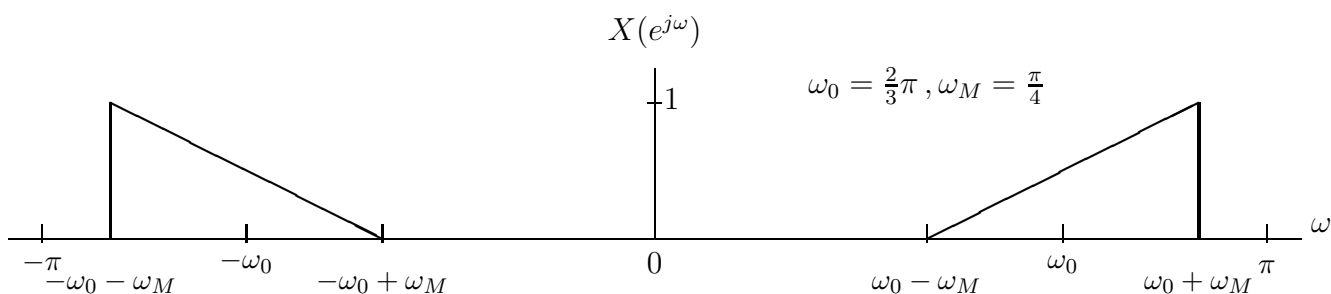
**Problem 2** Consider the following system:



$\downarrow m$  denotes downsampling by  $m$ , and  $\uparrow m$  denotes upsampling by  $m$  as illustrated below.



$x[n]$  is a real-valued DT signal whose DTFT for  $-\pi < \omega < \pi$  is given by



- Sketch the DTFT for  $x_c[n]$  and  $x_s[n]$  for  $-2\pi \leq \omega \leq 2\pi$ .
- How much can one downsample without aliasing, *i.e.*, what is the maximum integer value of  $m$  ?
- Design a system which recovers the signal  $x[n]$  from  $y_c[n]$  and  $y_s[n]$ .

**Problem 3** Determine the Laplace transform and the associated region of convergence and pole-zero plot for each of the following functions of time:

- $x(t) = e^{-t}u(-t) + 2e^{-2t}u(t)$
- $x(t) = (e^t \cos t)u(-t) + u(-t)$

**Problem 4** Determine the function of time,  $x(t)$ , for each of the following Laplace transforms and associated region of convergence:

- $X(s) = \frac{s - 25}{s^2 - s - 12}, \quad -3 < \Re\{s\} < 4$
- $X(s) = \frac{2s^2 + 7s + 9}{(s + 2)^2}, \quad \Re\{s\} > -2$

**Problem 5** O&W 9.24 (f)

**Problem 6** O&W 9.26. Also, determine if this system is stable and justify your answer.

**Reminder:** The first 20 problems in each chapter of O&W have answers included at the end of the text. Consider using these for additional practice, either now or as you study for tests.