MAKE-UP MIDTERM TEST
November 1, 2002

Instructions
In taking this examination, you agree that all work recorded herein is your own. A student caught in the act of cheating will be given a grade of F and a letter will be written to his or her file.
Write your name at the top of every sheet. Read the questions carefully. If something appears ambiguous, write down your assumptions. There is a total of 100 points for 75 exam minutes, so pace yourself accordingly.
Make sure you return this page with your examination booklet. Booklets without this page will automatically be given a grade of F.

Name: ________________________________

Problem 1
Provide the following definitions, making sure that you properly define each quantity involved:

1. Discrete-Time Fourier Transform (5 pts)
2. Discrete-Time Fourier Series (5 pts)
3. Discrete Fourier Transform (5 pts)

Also, prove that if \( F(\Omega) \) and \( H(\Omega) \) are the Discrete-Time Fourier Transforms of \( f[k] \) and \( h[k] \), respectively, then the Discrete-Time Fourier Transform of \( f[k] \ast h[k] \) is \( F(\Omega)H(\Omega) \). (10 pts)

25 points

Problem 2
Consider the system equation \( y[n+2] - y[n+1] + 0.24y[n] = 2.5f[n+1] - f[n] \) of a system with input \( f[k] \) and output \( y[k] \). Determine the impulse response. Is this system stable? What is the output for the input \( f[k] = 2\delta[k] + 3\delta[k-2] \)?

25 points

Problem 3
Consider a square pulse signal \( p[n] \) of amplitude 1, which extends from \(-M\) to \(M\). Express \( p[n] \) analytically (i.e., derive a mathematical formula that describes it). Find \( p_2[n] = p[n] \ast p[n] \), and plot the result. Compare with \( p[n] \). Can you guess the general form of \( p_3[n] = p_2[n] \ast p[n] \)?

25 points

Problem 4
Consider a discrete-time signal \( f[k] \) with Discrete-Time Fourier Transform \( F(\Omega) \). This signal is processed by a “compressor”, which produces at its output \( g[k] = f[2k] \). In other words, this system compresses time by using only the even samples of the original signal. Express the Discrete-Time Fourier Transform \( G(\Omega) \) of \( g[k] \) in terms of \( F(\Omega) \). How would your answer change if right before the input to the compressed we added a one-sample delay?

25 points