Math 791N (Wavelets) Course Info – Fall 2003

1. **Lecture Time and Place:** 11:30–12:45 TR, WHI-D 110
2. **Instructor:** Lixin Shen, Office 308F, Armstrong Hall
3. **Office Hours:** 11:00–12:30, MW, or by appointment
4. **Office Telephone Number:** 304-293-2011 ext. 2312
5. **E-mail Address:** lshen@math.wvu.edu
6. **Homepage:** http://www.math.wvu.edu/~lshen
7. **Textbook:** *Wavelets and Filter banks* by Gilbert Strang and Truong Nguyen
8. **Grades:** Grades will be assessed based on homework and project presentation.
9. **Attendance:** be taken daily. It might make a big difference for your final grade.
10. **Course schedule**

**Week 1:**
- 08/19 **Topics:** Convolution; Fourier transform; lowpass and highpass filters. **Reading:** Sec 1.1-1.4, 2.1
- 08/21 **Topics:** Upsampling and downsampling; fractional sampling; interpolation. **Reading:** Sec 3.1-3.3

**Week 2:**
- 08/26 **Topics:** Filter banks including conditions for alias cancellation and no distortion. **Reading:** Sec 4.1
- 08/28 **Topics:** Perfect reconstruction; halfband filters and possible factorizations. **Reading:** Sec 4.1

**Week 3: Homework 1 out**
- 09/02 **Topics:** Noble identities; block Toeplitz matrices and block z-transform; polyphase examples. **Reading:** Sec 3.4, 4.1-4.4
- 09/04 **Topics:** Orthogonal filter banks. **Reading:** Sec 5.1-5.2

**Week 4:**
- 09/09 **Topics:** Maxflat filters, Daubechies and Meyer formulas; spectral factorization. **Reading:** Sec 5.3-5.5
- 09/11 **Topics:** Multiresolution analysis (MRA). **Reading:** Sec 1.5, 6.1

**Week 5: Homework 1 due and Homework 2 out; Projects will be assigned**
- 09/16 **Topics:** Refinement equation; iterative and recursive solution techniques; infinite product formula; filter bank approach for computing scaling functions and wavelets. **Reading:** Sec 6.2-6.4
- 09/18 **Topics:** Orthogonal wavelet bases; biorthogonal wavelet bases. **Reading:** Sec 6.2-6.4, 6.5

**Week 6:**
- 09/23 **Topics:** Orthogonal wavelet bases; biorthogonal wavelet bases. **Reading:** Sec 6.2-6.4, 6.5
- 09/25 **Topics:** Mallat pyramid algorithm. **Reading:** Sec 1.6, 6.2

**Week 7: Homework 2 due and Homework 3 out**
- 09/30 **Topics:** Accuracy of wavelet approximations; vanishing moments. **Reading:** Sec 7.1
- 10/02 **Topics:** Smoothness of wavelet bases **Reading:** Sec 7.2-7.4
Week 8:
10/07 Topics: Smoothness of wavelet bases. Reading: Sec 7.2-7.4
10/09 Topics: Lifting. Reading: Sec 6.5

Week 9:
09/14 Topics: Lifting. Reading: Sec 6.5
09/16 Topics: M-channel filter banks Reading: Sec 9.1-9.4

Week 10: Homework 3 due and Homework 4 out
10/21 Topics: M-channel filter banks, multidimensional filter banks and wavelets. Reading: Sec 9.1-9.5
10/23 Topics: Finite signal processing. Reading: Sec 8.1-8.3

Week 11:
10/28 Topics: Smooth local Cosine Bases. Reading: Sec 8.4
10/30 Topics: Boundary filters and Wavelets. Reading: Sec 8.5

Week 12: Homework 4 due
11/06 Topics: Image de-noising algorithm.

Week 13:
11/11 Topics: High-resolution image reconstruction.
11/13 Topics: Project Presentations

Week 14:
11/18 Topics: Project Presentations
11/20 Topics: Project Presentations

Week 15: Thanksgiving break

Week 16:
12/02 Topics: Project Presentations
12/04 Topics: Project Presentations

Suggestions: Take notes.

Any suggestions and comments from you are highly appreciated.