**CT-505** : **Digital Signal Processing** **First Semester**

**Text Book** : Signals & Systems (2nd Edition)
by A. V. Oppenheim, A. S. Willsky, and S. H. Nawab

**Period** : **45** periods for 15 weeks (3 periods/week) (Lecture + Lab)

**Course Description**

This is a fundamental course in signals and systems. Signals in electrical engineering play an important role in carrying information. Signals going through a system are an inevitable process. It allows engineers to understand the system. Thus in this course the relationship between signals and systems will be taught. The concepts which are important include time and frequency domain representations, Fourier and Laplace transforms, spectrum of a signal, frequency response of systems, sampling theorem.

**Course Objectives**

- To study and analyze characteristics of continuous-time and discrete-time signals and systems
- To develop continuous-time and discrete-time concepts in parallel
- To familiarize with various signals and their transforms
- To provide a thorough understanding of the fundamentals of signals and systems required in the study of signal processing, communication systems and control systems.

## Assessment Plan for the Course

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| Paper Exam: | 60% |
| Attendance: | 10% |
| Test/ Quiz: | 10% |
| Lab: | 10% |
| Lab Assessment: | 10% |

**Tentative Lecture Plan**

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| | **Chapter 1** | **Signals and Systems** | | **5** | |
| 1. | 1.1<br>1.2<br>1.3 | Continuous-Time and Discrete-Time Signals<br>Transformations of the Independent Variable<br>Exponential and Sinusoidal Signals | 1-30 | 2 | |
| 2. | 1.4<br>1.5 | The Unit Impulse and Unit Step Functions<br>Continuous-Time and Discrete-Time Systems | 30-43 | 1 | |
| 3. | 1.6 | Basic System Properties | 44-56 | 2 | |
| | **Chapter 2** | **Linear Time-Invariant Systems** | | **10** | |
| 4. | 2.1<br>2.2 | Discrete-Time LTI Systems: The Convolution Sum<br>Continuous-Time LTI Systems: The Convolution Integral | 75-102 | 4 | |
| 5. | 2.3<br>2.4 | Properties of Linear Time-Invariant Systems<br>Causal LTI Systems Described by Differential and Difference Equations | 103-127 | 4 | |
| 6. | 2.5<br>2.6 | Singularity Functions<br>Summary | 127-137 | 2 | |
| | **Chapter 3** | **Fourier Series Representation of Periodic Signals** | | **12** | |
| 7. | 3.1<br>3.2 | A Historical Perspective<br>The Response of LTI Systems to Complex Exponentials | 178-186 | 1 | |
| 8. | 3.3<br>3.4 | Fourier Series Representation of Continuous-Time Periodic Signals<br>Convergence of the Fourier Series | 186-201 | 3 | |
| 9. | 3.5 | Properties of Continuous-Time Fourier Series | 202-211 | 1 | |
| 10. | 3.6 | Fourier Series Representation of Discrete-Time Periodic Signal | 211-220 | 2 | |
| 11. | 3.7 | Properties of Discrete-Time Fourier Series | 221-226 | 1 | |
| 12. | 3.8<br>3.9 | Fourier Series and LTI Systems<br>Filtering | 226-239 | 2 | |
| 13. | 3.10 | Examples of Continuous-Time Filters Described by Differential Equations | 239-244 | 1 | |
| 14. | 3.11 | Examples of Discrete-Time Filters Described by Difference Equations | 244-249 | 1 | |

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| | **Chapter 4** | **The Continuous-Time Fourier Transform** | | **9** | |
| 15. | 4.1<br>4.2 | Representation of Aperiodic Signals: The Continuous-Time Fourier Transform<br>The Fourier Transform for Periodic Signals | 285-300 | 3 | |
| 16. | 4.3<br>4.4<br>4.5 | Properties of the Continuous-Time Fourier Transform<br>The Convolution Property<br>The Multiplication Property | 300-327 | 4 | |
| 17. | 4.6<br>4.7 | Tables of Fourier Properties and Basic Fourier Transform Pairs<br>Systems Characterized by Linear Constant-Coefficient Differential Equations | 328-333 | 2 | |
| | **Chapter 5** | **The Discrete-Time Fourier Transform** | | **7** | |
| 18. | 5.1<br>5.2 | Representation of Aperiodic Signals: The Discrete-Time Fourier Transform<br>The Fourier Transform for Periodic Signals | 359-372 | 2 | |
| 19. | 5.3<br>5.4<br>5.5 | Properties of the Discrete-Time Fourier Transform<br>The Convolution Property<br>The Multiplication Property | 372-390 | 2 | |
| 20. | 5.6<br>5.7<br>5.8 | Tables of Fourier Transform Properties and Basic Fourier Transform Pairs<br>Duality<br>Systems Characterized by Linear Constant-Coefficient Difference Equations | 390-399 | 3 | |
| 21. | | Revision | | **2** | All |