CSE 402: DIGITAL SIGNAL PROCESSING

Credit Hours: 3
Contact Hours: 3
Grading: As per UET Rules

1. COURSE OUTLINE

This course introduces students with the digital processing of signals. The topics cover the analysis, design and implementation of discrete-time systems. The mathematical representation of digital signals, their properties and manipulations are studied. The paradigm for analysis of system is built and time domain and various transform domain techniques for the analysis of LTI systems are explored including z-transform and Fourier analysis. The concepts of frequency selective filters are developed along with the design of filters with given specification. Students are required to design, simulate their projects on MATLAB, Simulink and/or VisualDSP++.

1. WEEKLY COURSE OUTLINE:

Week #	**Contents**
Week 1	**Introduction** Introductory topics, classification of signals, analog-to-digital conversion
Week 2	**Discrete Time Signals** Representation of Discrete-time signals and their properties
Week 3	**Discrete Time Systems** Transformations of the independent variable, properties of discrete-time signals
Week 4	**Analysis of Discrete Time Systems** Time domain analysis of discrete-time systems using convolution sum and difference equations
Week 5	**Analysis of Discrete Time Systems** Time domain analysis of discrete-time systems using convolution sum and difference equations
Week 6	**Z-Transform** Computing z-transform, Properties of Region of Convergence for z-transform, Computing inverse z-transforms, Properties of z-transform

Week 7	**Z-Transform** Computing z-transform, Properties of Region of Convergence for z-transform, Computing inverse z-transforms, Properties of z-transform
Week 8	**Z-Transform Applications** Analysis of LTI systems using z-transform
	Midterm Examination
Week 9	**One-Sided Z-Transform** Computing one-sided z-transforms, Properties of one-sided z-transform, Analysis of LTI systems using one-sided z-transform
Week 10	**One-Sided Z-Transform** Computing one-sided z-transforms, Properties of one-sided z-transform, Analysis of LTI systems using one-sided z-transform
Week 11	**Frequency Analysis of Discrete Time Signals and Systems** Frequency domain representation of Discrete-time signals & systems and their properties
Week 12	**Frequency Analysis of Discrete Time Signals and Systems** Frequency domain representation of Discrete-time signals & systems and its properties
Week 13	**Analysis of Discrete Time LTI Systems in Frequency Domain** Response of LTI systems to sinusoidal & Exponential signals, Convolution in Frequency domain, frequency selective filters
Week 14	**Implementation of Discrete Time Systems** Structures for FIR Systems and IIR Systems
Week 15	**Filter Design Techniques** **FIR Filter Design** Linear phase filter design by windowing, Kaiser window Method
Week 16	**Filter Design Techniques** **IIR Filter Design** Filter design by impulse invariance, bilinear transformation
	Final Term Examination

2. MAPPING OF CLOS WITH PLOS:

After completing this course, students will be able to:

CLO #	Course Learning Outcomes (CLOs)	Level of Learning (Bloom's Taxonomy)	Program Learning Outcomes (PLOs)
1	Explain the working of digital signal processing systems and classify discrete time signals and systems into different categories.	Cog-2 (Comprehension)	PLO1 (Engineering Knowledge)
2	Analyze the discrete-time Linear Time Invariant (LTI) Systems in time and frequency domains	Cog-4 (Analysis)	PLO2 (Problem Analysis)
3	Compare different implementations of LTI systems.	Cog-4 (Analysis)	PLO4 (Investigation)
4	Design filters with desired characteristics which can be used for real world engineering problems	Cog-5 (Evaluating)	PLO3 (Design/Development of Solutions)

3. MAPPING OF CLOs WITH COURSE ASSESSMENT TOOLS:

Course Assessment Tools	CLOs			
	CLO 1	CLO 2	CLO 3	CLO 4
Assignments	✓	✓	✓	✓
Quizzes	✓	✓	✓	✓
Project			✓	✓
Midterm Exam	✓	✓	✓	
Final Exam		✓	✓	✓

4. RESOURCES:

- TEXT BOOKS
    - Discrete-Time Signal Processing Alan V. Oppenheim and Ronald W. Schafer, 3rd Edition, Prentice-Hall Signal Processing Series
    - Digital Signal Processing: Principles, Algorithms and Applications by J. P. Proakis and D. G. Manolakis. 4th Edition, Prentice Hall.
- REFERENCE BOOKS

- Digital Signal Processing: A Practical Approach by Emanual C.Ifeachor, 2nd Edition, Prentice Hall.
- Digital Signal Processing: A Computer Based Approach, 3nd Edition, Sanjit K. Mitra, McGraw-Hill