FIRST SEMESTER 2020-2021

COURSE HANDOUT (PART II)

Date: 18. 08. 2020

Course No: **EEE C434/EEE F434**

Course Title: **Digital Signal Processing**

Instructor-in-Charge: **HARSHAVARDHAN SETTIBHAKTINI** (Office no: 2247-E)
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1. Course Description:

The course deals with a set of fundamental signal processing concepts that are of prime interests in various related applications. It is mainly divided into four modules, wherein, the first module deals with the discrete-time Fourier transform, discrete Fourier Transform and fast Fourier transform. These transforms are very essential for estimating some of the important features of the signal and also lay the basic foundations for other advanced signal processing transforms. The second module will cover the underlying concepts and design of the continuous and discrete (or digital) filters. As filtering operations are required in most of the signal-processing related applications, it is utmost important to learn and understand these techniques and put them into practice. This module ends with a brief introduction of the adaptive filtering. The third module will introduce the topic of multirate signal processing. Using these techniques, the signal processors can alter the sampling frequency of the signal, as per their requirements. Finally, the fourth module will include lectures on applications of digital signal processing. This topic is highly-interdisciplinary and also discusses about the practical issues regarding the implementation of filters in different applications.

2. Scope and Objective:

To provide underlying concepts behind the fundamental transforms of signal processing, different methods of filtering operations and their applications, multirate signal processing and application of digital signal processing. Lab components involve MATLAB exercises, which will provide students to gain hands-on experience along with the concepts gained in the class.

3. Prerequisites: Signals and Systems (EEE F 243/INSTR F 243) is mandatory.

4. Text Books:

T1: S. K. Mitra, *Digital Signal Processing (3rd edition)*, McGraw Hill Higher Education, New York City, USA, 2005. ISBN-10: 0073048372.

T2: A. V. Oppenheim and R. W. Schafer, *Discrete-Time Signal Processing (3rd edition)*, Pearson, New Delhi, India, 2013. ISBN: 978-93-325-0574-2.

Other Reference Books

R1: J. G. Proakis and D. G. Manolakis, *Digital Signal Processing (4th edition)*, Prentice Hall, Englewood Cliffs, New Jersey, USA, 2006. ISBN: 978-0131873742.

R2: L. B. Jackson, *Digital Filters and Signal Processing (3rd edition)*, Kluwer Academic publishers, Norwell, MA, 1996. ISBN 978-1-4419-5153-3.

R3: A. V. Oppenheim, A. S. Willsky and S. Hamid, *Signals and Systems (2nd edition)*, Prentice Hall, Englewood Cliffs, New Jersey, USA, 1996. ISBN: 978-0138147570.

R4: MATLAB Online Tutorials.

R5: P. P. Vaidyanathan, *Multirate Systems and Filter Banks*, Prentice Hall, Englewood Cliffs, New Jersey, USA, 1993. ISBN: 007-6092032502.

Class lectures will be derived either from the text books or reference books and additional materials may be provided whenever necessary.

5. Course Plan:

Module	Lecture No.	Topics to be covered	Learning Outcomes
Introduction	1	Overview of the course.	
Continuous signals-to-Discrete sequences	2-4	Continuous time signals, Sampling theorem, Aliasing, Discrete time sequences and systems, Convolution.	Identify different types of continuous signals and discrete time sequences, understand how to convert the continuous signal into discrete sequence using the sampling theorem. Additionally, concepts related to convolution will be known.
Fundamental Transforms	5-12	Discrete Time Fourier Transform, Discrete Fourier Transform: properties,	Understand the Fourier transform using FFT algorithm and its limitation. The effect of

		windowing effect, zero padding and FFT computation.	windowing on signals will be known.
Filter Concepts	13-28	Overview of z-transform, Filter Characteristics, Filter types, Continuous Filters (IIR): Butterworth, Chebyshev, Elliptic. IIR Continuous-to-Discrete Filter conversion, FIR filters using Fourier series, windowing, and frequency sampling. Optimum approximation of FIR filter, advantages and disadvantages of using the FIR and IIR filters.	Understand and design different types of continuous-and-discrete filters. The advantages and disadvantages of each of these filters will be learnt through this module.
Realization of Digital Filters	29-32	FIR and IIR Filters Structures: Direct Form I, Direct Form II, Cascade form, Parallel form, Transpose, Polyphase representation	Understand the hardware implementations associated with FIR and IIR filters.
Adaptive Filters	33-34	Introduction and basic fundamental concepts of adaptive filtering.	Significance of adaptive filters will be learnt along with its applications.
Multirate Signal Processing	35-37	Decimation and Interpolation.	Understand the decimation and interpolation operations in time as well as in frequency domains
Applications of digital signal processing	38-42	Practical applications of digital signal processing.	Advanced signal processing algorithms will be discussed briefly to solve the real-world problems.

6. Evaluation Scheme:

Evaluation Component	Durations (Mins)	Weightage (%)	Date, Time and Venue	Remarks
Test 1	30 Min	15%	September 16th 2020	Open Book
Test 2	30 Min	15%	October 16th 2020	Open Book
Test 3	30 Min	15%	November 16th 2020	Open Book
Lab component	Announced in class	25%	Spread across semester	
Comprehensive	2 hours	30%	December 8th 2020	Close Book/Open book

7. Consultation Hour: Will be announced in the class.

8. Notices: Notices regarding the course will be displayed in NALANDA or Google class room.

9. Malpractice Regulations:

The following regulations are supplementary to BITS-wide policies regarding malpractices:

- A mal-practice will include but not limited to:

  - Submitting some other student's solution as one's own.
  - Copying some other student's MATLAB code or other forms of solution.
  - Permitting some other student to see or copy or submits one's own solution.
  - Or other equivalent forms of plagiarism wherein the student does not work out the solution and use some other solution or part thereof (such as downloading it from the LAN or Web).

10. Make-up Policy:

- A make-up test shall be granted only in genuine cases where - in the Instructor's judgment – the student would be physically unable to appear for the test.

- In case of an unanticipated illness preventing a student from appearing for a test, the student must present a Medical Certificate from hospital.
- A make-up may not be granted for any other evaluation components.

Instructor-in-Charge

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